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Helping the Bidders

AN UNUSUAL and extremely commendable plan for helping contractors bid intelligently on a \$1,000,000 road job has been worked out by the officials of Cook County, Illinois. To supplement the customary information, two maps of the county have been prepared—one to show the location of suitable sources of sand, gravel and stone; the other to indicate the location and capacity of railroad sidetracks. The railroad map also shows the highways under construction and therefore not usable, while the material chart gives, in tabular form, the names and addresses of the supply companies in the respective neighborhoods. By studying the maps, contractors can also determine those roads over which they will have to drive heavy motor trucks and can learn in advance the length of haul and in which towns they must obtain permits for their trucks to travel. The Cook County Department of Highways should be commended for making it easy for contractors to bid on this work. Moreover, the county will undoubtedly get returns, through lower prices, far exceeding the cost of preparing this helpful information. Elimination of uncertainties is a sure way of reducing costs.

Fakers

HERE is an opportunity for constructive work by every engineer and contractor. A number of anti-freezing compounds are on the market this winter, and their advocates are offering 10 per cent commission to architects who specify the use of the mixtures in concrete. Of two of the compounds analyzed, one contained 85 per cent of common salt, 5 per cent caustic soda and 10 per cent of powdered lime. Two pounds of the mixture were to be used to the bag of cement. The other compound analyzed 80 per cent common salt, 10 per cent soda ash and 10 per cent powdered lime; the instructions call for 3 lb. of the mixture to the bag of cement. Not only is the use of these compounds contrary to good practice—in that they employ salt—but the promoters are trying to undermine the educational work which has been done in the effort to make winter concreting safe. The agents and their literature are preaching against the use of heated water, contending that their compounds furnish the safeguard needed. Those who have given the matter consideration know that if the materials are heated, the structure properly protected and kept at the proper temperature, no other precautions need to be taken. If some architects and constructors do insist upon putting something in the mix, they should not, through a false sense of security, neglect the

ordinary heating precautions, and above all should not play the part of an ordinary "sucker" and pay fancy prices for common salt. Here is an opportunity for everyone to wield his hammer in a good cause.

Commissioner Daniels

RAILROAD managers find considerable encouragement in the confirmation by the U. S. Senate of the reappointment of W. M. Daniels as member of the Interstate Commerce Commission. There was strong opposition to him, in which Senator Cummins of Iowa is understood to have taken a prominent part. It was held that his advocacy of rate advances in the summer of 1914—shown by the railroad earnings of the last year, his opponents said, to have been unnecessary—disqualified him for further usefulness on the commission. The Senate was not fooled, however. It saw that the present wave of prosperity could not have been predicted in 1914. It probably saw further that even the large railroad profits during the past year have not been excessive, considering the preceding lean years, the doubtful durability of the present prosperity and the danger of further inroads on the railroad income by the brotherhoods. It must have seen, too, that members of the Interstate Commerce Commission must feel free to exercise their best judgment on the problems they investigate, without fear of a Senate that has not gone so deeply into the problems. Commissioner Daniels will therefore continue to exercise that judgment, and will probably continue to feel that a square deal for the railroads is not incompatible with service to the nation.

Official Status for Research

IT WILL BE of intense interest to all who have followed the discussions in this country of the relation of scientific research to industrial efficiency and to military and industrial preparedness to learn that the British government has set up an "Imperial Trust for the Encouragement of Scientific and Industrial Research," and has given it a status equal to that of the Board of Trade, the Board of Agriculture, and the other executive organizations comparable, in the English system, to our executive departments. In other words, industrial research has been given a national and official standing in England. Differing somewhat from the practice here, however, it is the expectation that the trust will be supported not only by Parliamentary grants but by gifts from individuals. In fact, two members of the Institution of Mechanical Engineers have already

made substantial contributions. It is further announced that the English Government expects to appropriate about \$5,000,000 for research work during the next five years. This action follows naturally the investigations which have been made since the beginning of the war—investigations which have been followed here by the organization of the National Research Council and its efforts to co-ordinate the investigational resources and abilities of the entire country. The English action, however, differs from our own in that our own efforts are purely private and that the government, without contributing funds, is participating only as would any private organization. If we eliminated the "pork" from our system we would have ample funds for aiding research work.

Has the Highway Engineer's Work Just Begun?

TO highway engineers there is a deep significance in the comparative figures for passenger service rendered by automobiles and steam railroads, given on page 112 by H. W. Perry, of the National Automobile Chamber of Commerce. His calculations show that for automobiles the total passenger-miles per year have reached the remarkable figure of 45,000,000,000 as against slightly more than 35,000,000,000 passenger-miles for the railroads. The latter figure, however, is based on statistics for 1914. Reduced to dollars and cents, the statistics indicate that automobile service, at 2 cents a mile per passenger, is worth \$900,000,000 yearly, or \$200,000,000 more than that rendered by all of the steam railroad systems of the country. It should be noted that these figures apply to pleasure automobiles.

As regards the motor truck, the story is different. While commercial vehicles are making rapid strides, they are still far behind the steam roads in ton-mileage of freight carried, the figures being less than 4,000,000,000 ton-miles yearly for motor trucks and 288,000,000,000 ton-miles for the railroads. Again the railroad figures are for the year 1914. Due to the immense increase in freight delivered for export, it is safe to assume that a comparison, based on the records of 1916, would show a still larger difference in favor of the railroads.

To the man who looks ahead a few years, these statistics furnish grounds for believing that, in spite of the millions of dollars that have been spent upon roads and pavements, the real work of the highway engineer has scarcely begun. To what proportions will motor traffic increase, say, in the next ten years? How will present standards of highway construction be affected? Will road widths and grades, sanctioned to-day, be adequate to-morrow? What influence will legislation have upon the conservation of our highways and the development of motor-propelled traffic?

These are some of the questions which occur to the highway engineer who digests Mr. Perry's figures. Upon them all sorts of speculation may be based. Cer-

tain it is, however, that the road-builder is destined to assume a position of far greater importance than he occupies to-day.

Flat-Slab Design

THE long-awaited final report of the joint committee on concrete of the American Society of Civil Engineers contains a most important contribution on the subject of flat-slab design—a moot question for the past few years. The committee, especially the subcommittee on design, consisting of Professors A. N. Talbot, W. K. Hatt, and F. E. Turneure, is to be congratulated on the clearness and definiteness of this new section. The subject was entirely omitted in the progress report of 1912, which has been so generally adopted by the engineering profession.

In the abstract, which appeared on page 55 of last week's issue, the important respects in which the methods recommended differ from present general practice were pointed out. Especially fortunate are the suggestions for the division of total bending moment between the positive and negative sections in the proportion of three-eighths and five-eighths, and the requirements for the distribution of steel across the sections, based upon new assumptions regarding the distribution of stress in these sections.

Knowing the personnel of the subcommittee on design, it was to be expected that conservative practice would be recommended—in fact, it will be noted that some of the provisions closely accord with the present Chicago building-code requirements. The treatment is both empirical and rational and, in the opinion of this journal, deserves general approval.

As a whole, the report is excellent. Especially to be commended are the increases in required time of mixing and the emphasis on the importance of the quantity of water. The former has been advocated by this journal for years. The latter it has repeatedly emphasized, particularly since the new knowledge has pointed out the grave necessity of reducing the customary volume of mixing water.

A Move for Better Contracts

THE first definite step has been taken toward securing equitable construction contracts under which the cost of carrying out engineering work can be reduced by laying all the cards on the table and eliminating needless uncertainties.

The General Contractors' Association, an organization numbering among its membership a large percentage of the important contracting firms of the country, many of whose officers, by the way, are prominent in the American Society of Civil Engineers, has appointed a committee to bring the whole matter to a head. It is expected that the work of this committee, the appointment of which has just been announced, will include, first, the determination of what general standards and principles should govern engineering contracts. Next,

it is believed, the committee and the association will bend every effort to secure the adoption of such standards by engineers.

Will the American Society of Civil Engineers wait until the second stage of these proceedings has been reached, and until contractors have forced its members to institute reforms that, after all, will be of most benefit to clients of the engineering profession? Such reforms should come from within. When they are forced from without, there is a serious reflection on the body reformed.

As this journal has said time and again, with all the emphasis at its command, a reform in contract practice among engineers is overdue, and is coming just as surely as it came in architectural work some years ago. The architects had the perception and the energy to join in and help work out their own salvation. Will the engineers do less? Can they afford to do less? Will they dare do less?

Immediate and definite action by the American Society of Civil Engineers, looking toward co-operation with the contractors who have initiated this movement, is required. Otherwise its members will be in the awkward position of being forced into a reform of which the society should have been the instigator.

New Tests of Steel Columns

WHILE the number of new tests reported this year by the special committee of the American Society of Civil Engineers is not large, the results confirm the tendencies previously announced for the extensive series of tests conducted by the U. S. Bureau of Standards under the co-operative auspices of the civil engineers' society and the American Railway Engineering Association. The latest progress report, abstracted on page 66 of last week's issue, gives the results of the three lines of investigation proposed in the previous report and lays down the plans for the future.

In the first place, the results for new short columns (slenderness ratio 20) duplicating the tests on sections from previously tested long columns show close agreement with the older results, both for ultimate strength and yield point, and confirm the suggestion made last year that lower yield points in compression for the heavier column material explain the lower strengths of columns made of heavier material. In the second place, results for extra-heavy sections of two types, tested for the purpose of finding whether the decrease in strength with thick material was progressive, indicate that for rolled H-columns this falling off in ultimate strength is extremely large for all three slenderness ratios tested, while on the other hand the thicker material in built-up I-sections caused but slight decreases in strength. In the third place, the results for long columns (slenderness ratio 155) appear to indicate much less reduction of strength due to length than would be expected.

The investigation of the metal in the columns by tensile tests of specimens cut from parts of the main

sections or by compressive tests of angles, as reported, is not extensive nor are the results convincing, except qualitatively, as indicating the fact that low yield points for thicker metal predict lower ultimate strength for columns of that material. The report reveals the uncertainty of the committee as to exact methods for determining the yield point of columns, and it is to be regretted that the tests were not conducted as suggested editorially in the Engineering Record of May 8, 1915, page 574, that is, by repeating the application of stress, without increase, as often as there are resultant increments of permanent set. It is believed that such a method of test would at once settle the question raised by the committee as to how the yield point of columns should be found. When the permanent sets are found to increase progressively without increased loading and possibly even under decreased loading, this point, similar to Bauschinger's "stretch-limit" in tension tests, will be known. The important influence of the time element, so far as the report indicates, has been given no further attention by the committee. The close relation between yield point of the metal, yield point of column and ultimate strength of column is recognized in this connection. The results of tests on large columns reported in the Engineering Record of July 1, 1916, page 19, should be mentioned as showing this same relation for various alloy steels.

As advocated editorially on page 68 of the Engineering Record for Jan. 15, 1916, it is peculiarly incumbent upon the society to see that these test results are exhaustively analyzed. It is hoped that the question raised as to the relation between yield points of the component metal in tension and in compression will be more definitely investigated. The few tests just reported show the yield point in compression to be about 2000 lb. per square inch lower than in tension for the material in the angles of the built-up I-sections. Thorough study of the completed test results now available to find an arbitrary deformation point which can be used as a criterion of the strength of the column and to fix the safe working values is proposed.

This journal repeats the suggestion made in the editorial previously mentioned that some of the columns already tested should be duplicated under the A. R. E. A. specifications in order to obtain a reasonable basis for estimating the strength of columns fabricated as in ordinary commercial practice. This can well be made part of the proposed investigation for determining the effect upon column strength of minor details such as lacing, tie plates, etc. While recognizing the claim of the committee that its duty does not require it to continue the investigations until the subject is exhausted, it is a fact that the original appointment of the committee "to consider and report upon the design, ultimate strength and safe working values of steel columns and struts" clearly requires a consideration of all the factors which affect the allowable working strength of columns—and this surely means an investigation to find the crippling loads on commercial columns, and their relation to the "gilt-edged" columns of these tests.

Form Travelers Hoist Canal-Wall Concrete

Excavation for Chicago's Calumet-Sag Channel, Made by 328-Ton Shovel, Flanked by Concrete Walls Built with Special Plant Developing New Economies

By E. P. ABBOTT

Engineer, A. Guthrie & Company, Blue Island, Ill.

TRAVELERS in use on sections 13 and 14 of the Calumet-Sag Channel at Blue Island, near Chicago, not only carry the steel forms for 50-ft. wall monoliths, but also hoist the concrete skips from trains on the lock floor and discharge their contents mechanically to any part of the form. A large central concrete plant is in use. The cement is unsacked in the cement shed and supplied to the mixers by long chutes through the aggregate bus. The main canal section is being excavated by a 328-ton revolving steam shovel able to make the full cut and load disposal trains on the bank.

WORK INVOLVES LARGE QUANTITIES

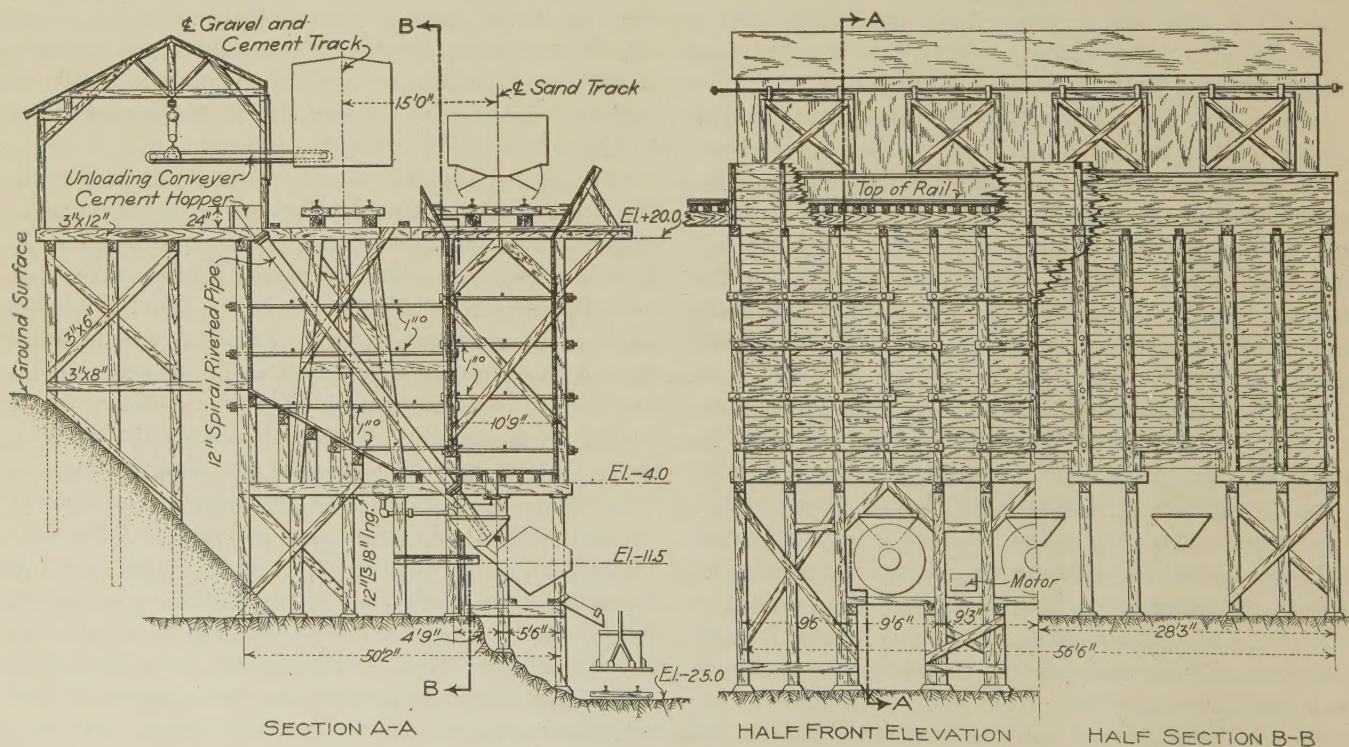
The Calumet-Sag Channel is a 16-mile drainage and ship canal that is being built by the Sanitary District of Chicago to carry the sewage from the Calumet district into the drainage canal. The channel extends from the Little Calumet River, near Blue Island, Ill., to a junction with the Sanitary and Ship Canal of Chicago near Sag.

Sections 13 and 14, which are the two sections at the east end, are now well under way and involve heavy, difficult construction work. Section 13 is within the corporate limits of the city of Blue Island and includes two main-line railway crossings. Section 14 adjoins the river and contains the controlling works and sewage-discharge chamber. The two sections together are $2\frac{1}{4}$ miles long, require the excavation of approximately 1,500,000 cu. yd. of glacial drift and rock and the placing of 190,000 yd. of concrete, 500 tons of structural

steel and 4000 tons of reinforcing metal. This portion of the channel is to be lined on both sides with gravity concrete retaining walls, which are 50 ft. face to face in the controlling-works section, 100 ft. in the 1000-ft. lie-by and 63 ft. in the standard section. The walls vary in height from 26 ft. in the standard section to 40 ft. at the controlling works.

REVOLVING SHOVEL SELECTED FOR EXCAVATION

Because of the irregular and restricted spoil areas and the fact that the top of spoil is limited to a fixed elevation, which makes the maximum fill 20 ft. with the average about 10 ft., it was not economical to do the work of excavating with dragline machines. The main channel excavation is being made with a Model 300 Marion steam shovel, which is the largest type of shovel yet built. The shovel is of the revolving type, weighs 328 tons and is equipped with an 80-ft. boom, 52-ft. dipper stick and an 8-yd. bucket. It operates on two tracks 26 ft. center to center and is mounted on four swiveling trucks, each having four 30-in. double-flanged wheels, all of which are geared direct to the propelling engine. An equalizing device, which gives all the flexibility of a three-point suspension, consists of four hydraulic cylinders with pistons connected to the trucks. Hand circulating pumps operate the pistons and permit the machine to be moved over uneven track without torsional strains in the lower frame resulting from unequal distribution of the weight. The shovel will excavate a cut 116 ft. wide at grade and will load



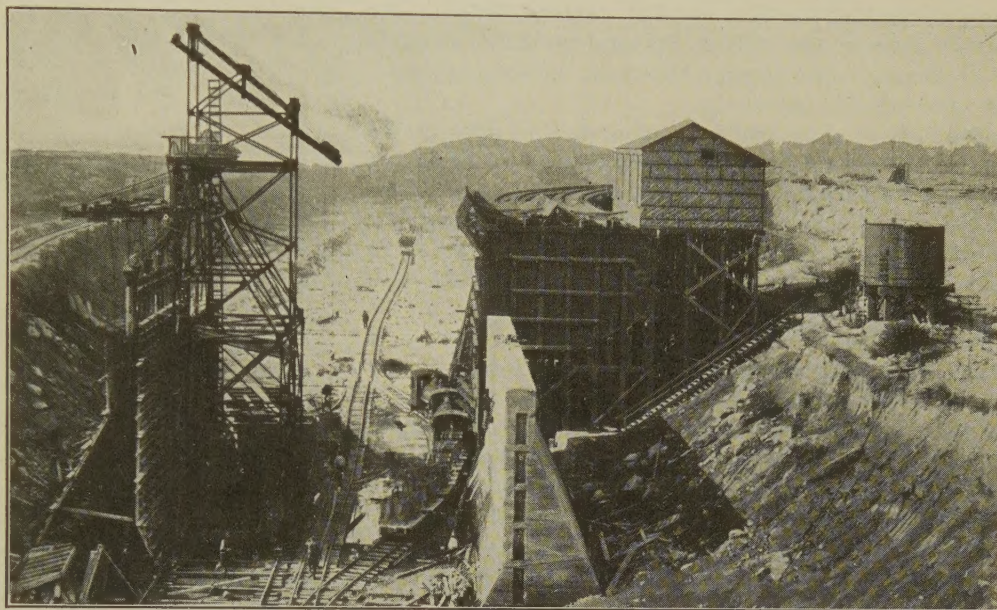
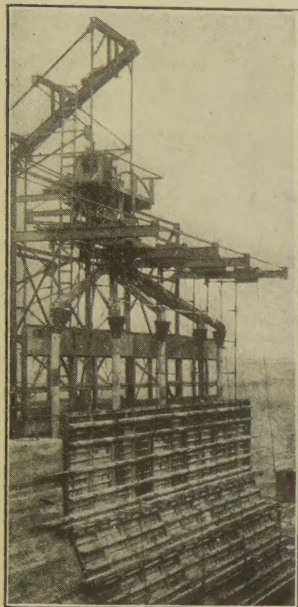
CEMENT SACKS NEVER LEAVE THE HOUSE IN GRAVITY CONCRETE PLANT, WHICH LOADS 6 BUCKETS IN 2 MINUTES

carts 58 ft. above and 95 ft. from its pivotal center. It has been possible in all but the lie-by section to make the cut the required width from one position in the center of the channel.

The excavated material is loaded into standard-gage 20-yd. Kilbourne & Jacobs air dump cars, which are hauled by 67-ton Baldwin locomotives to the nearest spoil area. These areas are located along both sides of the channel. The fills are started by dumping from trestles, the cars being pushed out ahead of the locomotive and dumped. When a trestle is filled it is dozed

ing is being done with Ingersoll-Rand Jackhammer drills, with air furnished by two Chicago Pneumatic Tool Company's fuel-oil, direct-connected compressors, each with a capacity of 325 cu. ft. of free air per minute.

The Jackhammer drills were selected after test runs were made by the different companies furnishing air-operated hand drills. The requirement was that 13-ft. holes should be bottomed to $1\frac{1}{2}$ in. with seven changes of steel. The best results obtained by these tests for 84 lin. ft. of holes drilled were: Total drilling time,



FORMS HUNG ON STEAMBOAT RATCHETS—DISTRIBUTING SPOUTS SAVE SHOVELING—FORM TRAVELER OPPOSITE CONCRETE PLANT

out 16 ft. on each side with a Jordan spreader propelled by locomotive, and the track is then thrown out to a new position on the shoulder by the dump.

TRACK-THROWING DERRICK CAR USEFUL

The track is handled by a track-throwing derrick car, which is a 10-ton derrick with a 40-ft. boom mounted on a standard flat car. The car is equipped with a removable auxiliary horizontal boom 35 ft. long that fits into either of the two foot castings mounted on the forward corners of the car and is held in a fixed position by a strut and cables. By means of a chain bridle the track, ties and all, is picked up vertically by the load line and is then pulled to the side by a line attached to the bridle, which passes over a sheave at the point of the auxiliary boom and back to a nigger head on the engine. The car, which is self-propelled, starts at the end of the track to be moved and backs away from the thrown track. The track is thrown from 4 to 6 ft. at a time, which is as much as it will stand without bending the rails and breaking the angle bars. The derrick is equipped with a three-drum hoisting engine and four nigger heads independently operated by clutches. Besides throwing track, the car unloads heavy material, carries material from one part of the job to another, and does a great many other things that can be accomplished by it more easily and cheaply than by any other means.

The rock encountered is Niagara limestone in nearly horizontal strata overlaid with glacial drift. All drill-

ing includes delays incident to the changing of steel, blowing out of holes, etc., 1.78 minutes per linear foot of hole; and actual cutting time, 0.94 minute per linear foot. A record is kept of the linear feet drilled each day, which has averaged 139 ft. per man per ten hours, with the best day's average 234 ft. The holes vary in depth from 3 to $10\frac{1}{2}$ ft. and average between 6 and 7 ft. The steel used is $\frac{7}{8}$ -in. hollow hexagonal, and the best results have been obtained with cross bits.

DRILLED HOLES CARRIED BELOW GRADE

The drilled holes are carried 18 in. below grade to insure the rock being broken sufficiently low, and are spaced a distance apart equal to two-thirds the depth of the holes. The top two to three layers of rock are separated by clay seams, which have made drilling difficult because the drills often wedge and stick between the layers. These clay seams have also interfered with the blasting, the strength of the blast being dissipated through the seams. In some places it is necessary to reload and shoot the bottom 2 to 3 ft. of the holes after the top rock, broken by the first blast, has been cleared away.

The blasting is all done with electric current, and from 250 to 500 holes are shot at once. At first the dynamo that furnishes current to light the shovel was used. However, it did not have sufficient capacity, and now 220-volt alternating current, obtained from the local electric company, is employed.

The concrete-mixing plant, as shown in the drawing,

is a gravity plant even to the method of getting the cement to the mixers. Washed sand and gravel are received in hopper bottom cars. The cars are set on the contractors' storage tracks by the railroad company and the contractors' forces do all the necessary switching. A trestle with a maximum height of 48 ft. connects the top of the spoil bank with the bunker plant, which is built flush with the north face of the finished channel wall. The sand track is laid out in a 12-deg. reverse curve from the spoil bank and the gravel and cement track switches off from it. The two tracks become tangent at the bins on 15-ft. centers, which is the correct spacing for storing the proportionate amounts of aggregate. The storage bins hold sufficient material for 1000 yd. of concrete.

The cement shed, which is supported on piles at the side of the gravel bins, has a capacity of 2000 bbl. of cement. The floor of the shed is $6\frac{1}{2}$ ft. below the floor of the cars, so that practically none of the cement has to be trucked up grade. The plan is to install an 18-ft. portable electrically driven belt conveyor which will hang from an I-beam track running the length of the building. The conveyor will be carried on rollers in a sling, which will be hung by a chain block from a carriage on the I-beam. This will allow the conveyor to be pulled out to a bearing on the car floor, while with the chain block the unloading end can be elevated and lowered as desired. With this arrangement the conveyor may be used at any one of the four doors of the cement shed.

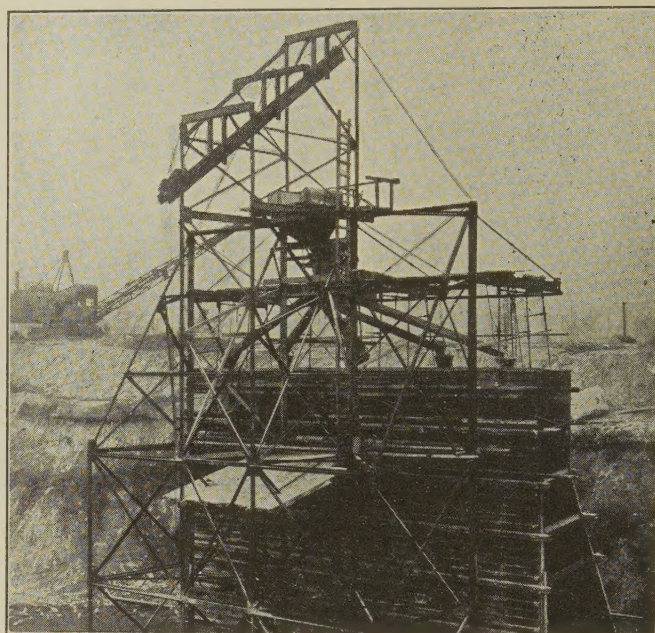
CEMENT FED THROUGH PIPES

Cement is fed to the mixers through 12-in. spiral-riveted pipes, which extend from the cement shed to the charging hoppers at the mixers through the gravel bin. The correct amount of cement for one batch is measured into one of the cement charging hoppers and is held until a gong signal is received from the mixer operator to release it by opening the sliding gate at the floor level. The original plan was to have an airtight valve at the lower end of each cement pipe, which would be opened by the mixer operator as he discharged the batch into the mixer. It was found, however, that the cement acted like water under pressure, and as soon as the flap gate was unlocked and raised the least amount from its gasket seat the cement poured out all around the opening to such an extent that considerable cement was lost. The great amount of dust made this method impracticable. To overcome this difficulty 6-ft. extensions, which taper from 12 to 5 in., were placed on the ends of the pipes in place of the valves. This brings the discharge well down into the charging hopper and under the sand and gravel, which act as a seal against the force of the cement as it comes down the pipe. A small hole drilled in each extension acts as an indicator, so that the operator will know that the cement signaled for has been received. The scheme has proved entirely successful and very economical. It will be noted that the cement sacks never leave the cement house. In this way all loss of sacks is eliminated.

The mixing is done in three 30-ft. Smith mixers, each direct-connected to a 25-hp. motor. All the levers are so placed that only one man is required to charge and dump each mixer. The concrete is discharged into 36-ft. capacity bottom-dump buckets on cars and is hauled

on the bottom of the channel to the forms. The cars are so spaced that they are a distance apart equal to the distance center to center of the mixers. Three cars per train, with two buckets to a car, are used, making 6 yd. per train. As soon as the train is spotted in front of the mixers each machine discharges the batch it is mixing. A second batch, which is held in the charging hopper, is emptied into each mixer as soon as it is righted, and by the time the train is again spotted the second batch from the mixers is ready to be discharged. By this arrangement the time of loading is less than 2 minutes for six batches of concrete.

Six sets of steel forms, each 50 ft. in length, and hung from cantilever steel travelers, are used for the canal walls. The travelers are placed in the bottom of



TRAVELER HOISTS AND DUMPS OWN CONCRETE BUCKETS

the excavated channel and are carried on eight two-wheel trucks on rails 15 ft. apart. The central portion of each traveler extends up beyond the forms and carries an inclined track made of two 12-in. channels back to back, on which is mounted a four-wheel trolley. By means of a 7 x 10 hoisting engine placed within the traveler the concrete buckets are hoisted from the cars in the bight of a line to the trolley, and then driven up the inclined track to a latch, so placed that the buckets are centered over a receiving hopper of 3 yd. capacity, placed just inside the front columns of the traveler. As the hoisting engineer slacks away, the bucket is lowered to a bearing on projecting angles bolted to its sides, and as the lowering continues the bottom of the bucket, which is held shut by the bail, opens and the concrete is discharged. Upon a signal the engineer picks up the bucket, which closes the bottom, and hoists it to the trolley. The latch is then disengaged by one of the men on top and the bucket is returned to the car. The buckets, engines and hoisting apparatus were furnished by the Mead-Morrison Manufacturing Company.

At the bottom of the receiving hopper is a gate which regulates the flow of concrete into a small bottomless hopper, which is pivoted in the center. By means of a long handle that travels along a curved beam it can be moved so that the concrete will be dis-

charged into any one of five chutes. These chutes terminate in line hoppers that center over the top of the forms 10 ft. apart. From these line hoppers, down spouts in 2-ft. lengths are hung down into the forms. With this arrangement of chutes all shoveling of concrete is eliminated and the concrete is easily brought up in horizontal layers.

FLEXIBLE DESIGN REDUCES NUMBER OF FORM PLATES

Steel forms are used with all the travelers. On the four travelers for the 26-ft. walls Blaw standard lagging plates are used. For the 40-ft. walls a new steel, hand-handled form is made use of, built up of 30-in. square plates, which fit between uprights 7 in. wide, which form part of the face of the form. Walers and lock bars fastened to the uprights by special hook bolts, which are made tight by wedges through slots in their ends, hold the plates in position. The walers are long enough to fasten on three uprights, while the lock bars break on each upright. The walers and lock bars alternate vertically, so that by removing the lock bars the plates may be removed without disturbing the uprights, which are held in position by the walers. As the tie rods pass through the uprights it is possible to erect, line and place the uprights to the full height of the form, while the plates need only be erected for the lower part. After the lower concrete has set, the plates can be taken down and fitted in above between the uprights that are already in position. This makes a light, flexible form that is easily handled by hand. After the standard walls have been poured with these forms, hung from the travelers, they will be removed and used for the special work at the gate recesses and curved walls as hand-handled forms.

RATCHETS ATTACH FORMS TO TRAVELERS

The forms are attached to the travelers with steam-boat ratchets, by means of which they are raised, lowered and collapsed, as desired. When a form is ready to be moved, the traveler is pulled forward by an 18-ton dinkey locomotive with the aid of double blocks. The travelers, with the forms and counterweight for the larger walls, weigh 100 tons, but are easily pulled by the dinkey after they are once started with the aid of pinch bars. The actual moving time after everything is made ready is only a few minutes. The travelers were designed in conjunction with the Blaw Steel Construction Company, which furnished the steel forms.

The work on sections 13 and 14 is being done by A. Guthrie & Company, Inc., contractors and engineers, of St. Paul, Minn., and Portland, Ore. William H. Trinkaus is resident engineer for the Sanitary District of Chicago. Robert M. Knox is general superintendent, Dan T. Chamberlain superintendent on section 13, and Walter A. Byers superintendent on section 14, and the writer is engineer for the contractors.

Queer Accident Burns Up Road

An unusual accident which destroyed an oil distributor, tank and 100 ft. of road surface is recounted in the latest annual report of the Arizona State Highway Department. A live coal, dropped on the road by the steam roller pulling the oiling equipment, ignited the hot-oil spray and set fire to the oiling equipment.

Concrete Adapted to Storage and Industrial Uses

Examples of Successful Application of Concrete in New Fields Cited by J. E. Freeman—Oil and Gasoline Do Not Affect Good Concrete

SUPPLEMENTING the article in the Engineering Record of Oct. 14, 1916, page 470, which gives results of tests made for the Portland Cement Association to determine the effects of commercial liquids on concrete, there is here presented an abstract of the paper by J. E. Freeman, engineer of the technical division of the association, read at its December meeting. The adaptability of concrete in the form of storage tanks for such materials as mineral oils, gasoline and kerosene, creosote oil, molasses, pickling brine, and digester liquids has been investigated and the returns as given by Mr. Freeman are seen to be favorable to concrete. Especially under the conditions prevailing in the steel field during the last year, concrete is thus shown to be an economical material for such tanks.

ADVANTAGES OF UNDERGROUND TANKS

In considering the subject of storage of mineral oils, it is stated that the best type of construction for concrete oil tanks of moderate capacity (500 to 30,000 bbl.) seems to be the underground tank, which keeps the oil at fairly even temperature and reduces the risk of fire from lightning or other causes. There is also a saving in the gasoline value of crude oil by the checking of evaporation, which one company estimates at 15 to 20 per cent as compared to steel tanks above ground. Insurance on oil storage is reduced 50 per cent for such an underground tank, in addition to the saving in the reduction of maintenance and repair costs.

Two tanks for storage of lubricating oil have been reported in service for 6 and 9 years respectively without effect upon the strength of the concrete. A small demonstration tank of 250 bbl. capacity at Sapulpa, Okla., has held gasoline for more than a year, and has resulted in the construction of a 2500-bbl. tank, which has recently been placed in service. The inside of this tank was given a special coating, but in view of the reported success of underground storage tanks for gasoline in Canada with only a rich mortar finish, this matter is worthy of further investigation. Several firms plan to build creosote-oil tanks this coming year, and as the specific gravity is close to that of fuel oil it is believed that the construction will prove satisfactory.

CONCRETE TANKS FOR MOLASSES

Reports from Missouri describe two concrete tanks, each for 7500 bbl., which cost 20 per cent less than similar steel tanks for the storage of molasses. Underground tanks for the same purpose have been reported in use for from 6 to 14 years and have proved very successful. In many cases, beyond plastering with mortar, no special coating was attempted, and no effects have been observed either upon the strength of the concrete or the quality of the molasses.

A pickle and preserve company in Utah had twenty 5000-gal. tanks built four years ago. They are filled with brine and vegetables, such as cucumbers, onions, cauliflower and sauerkraut. After one year's service

the tanks containing cauliflower showed evidence of slight action, and were coated with well-drying oil paint. In all cases the other tanks have been operating with complete success. At an olive growers' association plant in California 600 concrete vats built in pairs some 10 years ago are used for olive pickling, involving lye solution and brine, and they show no effects from action of any kind.

Finally, reference is made to the use of concrete for digester tanks in the paper-manufacturing business. Such a tank, 15 ft. in diameter and 42 ft. high, provided with special acid-proof lining, was constructed about four years ago at Austin, Pa. It operates under 100 to 150 lb. steam pressure, and the company considers it superior to other types. No trouble has been experienced, and a recent test showed no leaks. The advantages claimed are low initial cost, small loss in radiation and long life of linings.

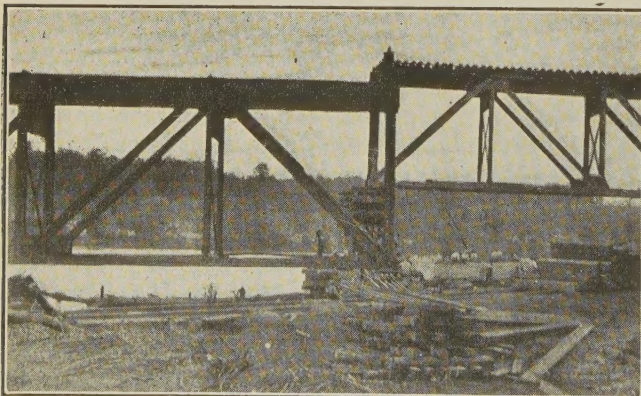
Three Washed-Out Steel Spans Replaced in Ten Days

Rapid and Difficult Salvage Work Follows July
Flood Damage to Southern Railway
Bridge Near Fort Mill, S. C.

UNUSUAL reclamation work marked the strenuous efforts of the Southern Railway to put its lines in North Carolina and South Carolina into operation again after the complete tieup following the washout of bridges over the Catawba River in the disastrous flood which reached its highest stage on July 16. The bridge near Fort Mill, S. C., where eight deck truss spans were carried several hundred feet down the river and the masonry piers badly wrecked, was rebuilt by timber trestle and the replacement of three of the 100-ton steel spans, and service was resumed Aug. 7 on the Charlotte-Columbus line.

The replacement of these spans, which had been turned over and floated away practically without damage, was accomplished in about ten working days in spite of high water difficulties, while the trestle work was being pushed from the opposite end. Timber cribs and blocking, high-speed jacks, cables, a derrick car and a wrecking crane were utilized in righting the spans and shifting them, in some cases as much as 500 ft., to restore them to their original position.

The Southern Railway lines were cut completely by the July flood at four points on the Catawba River.



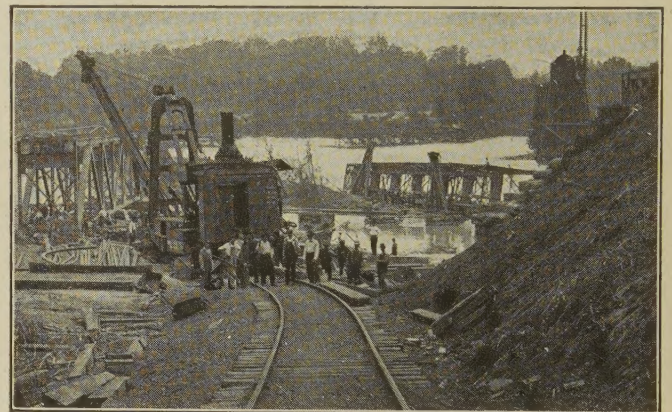
END SPAN PLACED—SECOND SPAN RIGHTED

The bridge at Belmont, N. C., on the main artery of travel between the North and the South, was restored thirteen days after it went down, five days being required to replace 600 ft. of embankment on the approaches. Piling from 75 to 90 ft. long had to be driven to support the trestles and temporary spans. When this bridge suddenly gave way on July 16, seventeen employees of the railroad, who were attempting to save the structure by freeing the drift under it, were swept into the river, and ten lost their lives.

EIGHT SPANS OVER CATAWBA CARRIED OUT

Eight 125-ft. spans over the Catawba River near Fort Mill, S. C., also were carried out, but with practically no damage to the steelwork. In addition to the work of placing timber trestles on piles, which was carried forward continuously night and day, it was possible to replace three of the 100-ton steel spans on the north end in the same time, and traffic was restored on Aug. 7. The methods used are indicated by the photographs.

These three 100-ton steel deck spans, 125 ft. long, 16 ft. wide and 22 ft. deep, which lay on the river bed

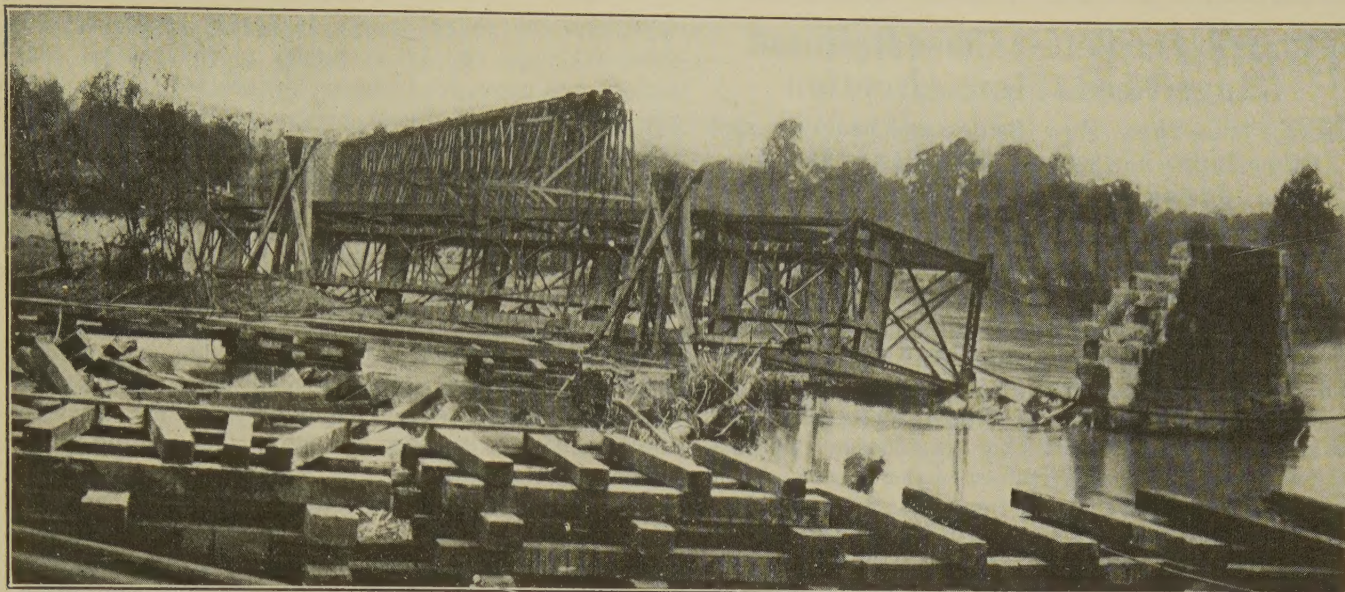


TEMPORARY TRACK FOR DERRICK CAR

either on their sides or upside down, were righted by high-speed jacks and timber frames (see photographs), aided by steel cables and a derrick car. After righting, they were shifted laterally back to the piers by the usual methods, using steel rollers on steel rails. These were laid upon 8 x 16 in. timber stringers spanning between 10 x 10-ft. timber cribs sunk in from 6 to 8 ft. of water. These cribs were made of 8 x 10 and 7 x 16-in. timbers drift-bolted together, and were difficult to place because of the interference of rubbish and large stones washed out of the piers. They were anchored to the piers or shore by cables to prevent the swift current from carrying them away.

When the end span had been moved back to the site, its shore end was lifted by a wrecking crane, as indicated in one of the photographs, and the other end was jacked up on temporary timber blocking on and around the damaged masonry pier. This span was thus raised and adjusted into its proper position and the wrecking crane run out upon it to aid in lifting the adjacent span.

Meanwhile the next two spans had been shifted back to the piers, lashed together and all preparations made to jack and hoist them into place as one unit up to the



TIMBER CRIBBING SUPPORTS RUNWAY RAILS FOR SHIFTING END SPANS BACK TO PLACE

top of the piers. The platform for jacking them up 12 ft. higher to their final position was made by 12 x 12-in. timbers laid crosswise on the piers and extending as cantilevers on each side about 6 ft., for working platforms. As the jacking proceeded 12 x 12-in. timbers were placed under them alternately crosswise and lengthwise.

Three spans were thus replaced by the time the other five openings had been closed by the trestle work which can be seen in the photographs. It required about ten working days with a force of 100 men, about 90 of whom were common colored laborers available in the vicinity and were used for excavating and clearing out the great masses of rubbish and handling the large amount of timber which was necessary to perform the work.

EMERGENCY TRANSFER OF CONTRACTOR

The replacement of the steel spans was done by the Southern Railway Company's forces, assisted by the John Eichleay, Jr., Company, of Pittsburgh, at that time employed by the company to move its passenger station at Danville, Va., the forces being transferred to Fort Mill to assist in the emergency. Forces from the Seaboard Construction Company, of Baltimore, were

also employed. The temporary trestle was built by the railway forces.

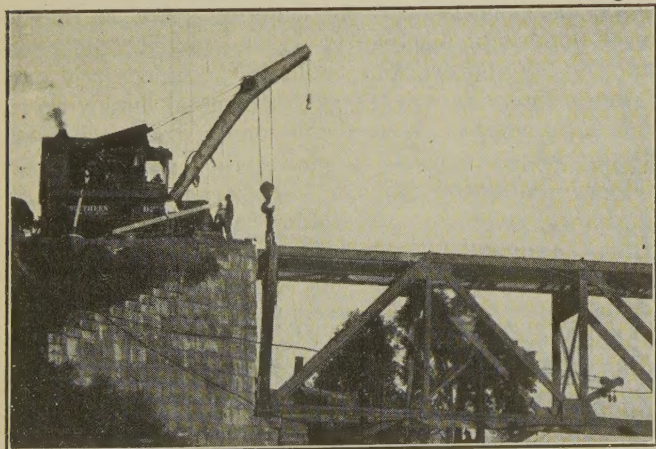
Since the track was opened for traffic the remaining steel spans, some of which were 500 ft. from the site, have been put back in place by the railway company's forces. The average time per span to do this was $4\frac{1}{2}$ days, which included pulling the spans back to a point opposite the temporary track where they were to be replaced, raising them to the proper height, removing the temporary structure and shifting the span in position ready for traffic.

The spans that were farthest removed from the original site were brought back by the use of steam derricks and a Lidgerwood unloading machine. Before bringing the spans up, three lines of 7 x 16-in. stringers, three stringers to each line, securely bolted together, were laid from the spans to the bridge site. The spans were then turned over on these stringers, and heavy chains with long cable lines from the derricks and Lidgerwood machine were made fast and the spans drawn up opposite the point where they were to be replaced in the structure.

DERRICKS AND CRIBBING DO WORK

Derricks were then fastened to one end of the span, and this end was lifted 4 ft. above the opposite end, and after raising it the height mentioned, cribbing was brought up underneath. Then the derricks were transferred to the opposite end, which was raised 8 ft., making it 4 ft. above the end first raised, and this end cribbed up. This was continued, shifting the derrick from one end to the other until the bridge was brought to the proper height, 65 ft., after which well-oiled rails were placed underneath and the bridges set upon them. The trestle was then removed, and a derrick at each end alternately lifted one end and then the other until the bridge was in its proper alignment.

The minimum time required to take out the trestle and put the span in after it had been lifted to its proper height and the ties and rails placed upon it was two hours and fifty minutes, and the maximum time was three hours and twenty-seven minutes.



WRECKING CRANE LIFTS THE END SPAN

Housing of Better-Class Railroad Gangs Needs More Attention

Three Plans Show How Bridge-and-Building and Other Maintenance Men Can Be Given Better Living Quarters at Low Cost

By J. T. BOWSER

Maintenance-of-Way Department, Queen & Crescent Route, Danville, Ky.

THE LABOR problem in the railroad maintenance-of-way department is a question of many phases, and, after the rate of pay, the working conditions, or more properly the living conditions, determine to a great extent the quality of labor obtained and the success with which men are retained in the service. With some exceptions the quarters furnished for the bridge-and-building and extra gangs (with which this article will deal exclusively) consist of obsolete box cars more or less remodeled and equipped with bunks or other provision for sleeping; and in the opinion of the writer too little attention is given to sanitation, comfort and provision of space and after-work loafing and recreation.

Attention to these particulars is especially necessary on bridge-and-building, signal-department, and other gangs on which native white labor is employed. The majority of these men have homes, many have families of their own, and they have a right to expect something more than the ordinary box-bunk car, which under the best of conditions is kept sanitary and free from vermin with much difficulty. And having been used to moderate comfort and at least some social intercourse at home, they can hardly be expected to be entirely contented in cars where it is almost impossible to be comfortable and where no place is provided to spend the evenings after work, so that they must sit on the edges of their bunks or around the small stove in the restricted space in the center of the car. The more desirable men, particularly the mechanics in the signal and bridge-and-building departments, are steady men of family, not roisterers, and stay pretty close to camp.

A substantial betterment of these conditions can be obtained at a cost not at all out of proportion with the advantages to be gained, and in the accompanying sketches some suggestions along this line are offered. While the quarters usually provided for negro gangs and gangs of foreign laborers are far from ideal, their betterment is largely a question of ventilation and sanitation, and these sketches do not concern themselves

with cars for gangs of this character except for the foreman, since no radical change in the present construction is necessary to secure the desired results. For the mechanics and better classes of labor, cars of a different class are recommended. Numbers of old non-vestibule coaches are being replaced with coaches of more modern types, and few railroads are without several such cars, which should be available for conversion into camp cars for these gangs.

ACCOMMODATIONS FOR TEN

Fig. 1 is a sketch of a car for a bridge or carpenter gang, which under ordinary maintenance conditions consists of an average of eight or ten men. Thus in one car space is provided for the kitchen, dining-room, foreman's-room and sleeping accommodations for the men, and the entire camp outfit consists of one converted coach and one tool car, releasing two or more cars of the ordinary type. Both sides of the coach having windows for the entire length, sufficient ventilation is assured, and the dining-room affords ample space for

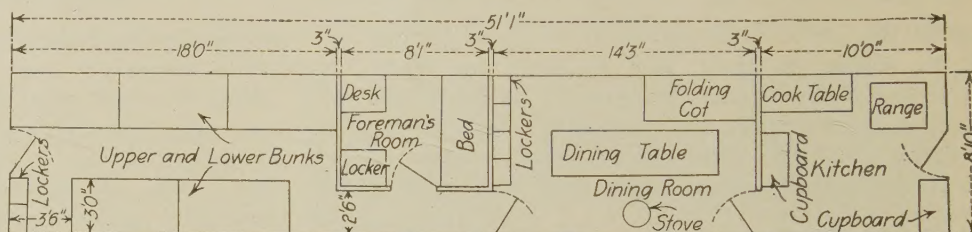


FIG. 1—FOR AN EIGHT OR TEN-MAN BRIDGE OR CARPENTER GANG

after-work loafing. Metal bunks, of which there are many types on the market, are more sightly, comfortable and sanitary than the wooden bunks, and these should be installed.

In this car, space is also allotted for the hand tools, which are usually the personal property of the mechanics, and each man is provided with a locker in which to keep clothes and other personal property.

FOR A LARGE BRIDGE GANG

For a larger gang, such as one on concrete work, or one on special bridge or building work requiring more than the usual number of men, a car designed like that shown in Fig. 2 would probably be found more satisfactory. While this car has sleeping capacity for only the same number of men as the car shown in Fig. 1, special provision is made for lounging space, so that a larger number of men can be accommodated. Sleeping quarters for the overflow could be provided in a car of the ordinary type equipped with metal bunks, or if enough old coaches are available, one of these equipped with bunks alone would accommodate a large number of men. A special car for kitchen and dining-room

would be necessary for a gang of this size. A converted box car would be entirely suitable for this purpose.

Fig. 3 is a sketch of an old coach designed for the foreman, assistant foreman and other white employees in charge of a gang of negro laborers, with space for

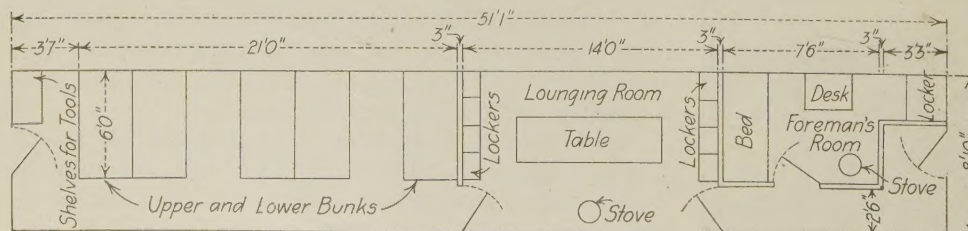


FIG. 2—FOR A LARGE SPECIAL BRIDGE OR BUILDING CREW

the pantry and kitchen for the entire gang. The commissaries on these gangs are usually operated by the foreman on his own account, or for the railroad company, and in either case supplies must have close supervision and must be carefully protected from theft. On such a gang the dining car for the men, for which purpose a box car could be used to advantage, would be located next to the kitchen end of the foreman's car, and the sleeping cars for the men would be located next in order. An outfit for a gang of this character would consist of a tool car, the foreman's car, dining car and two bunk cars, arranged in the order named. The laborers' dining car, which under this arrangement would contain only the table and benches, could be left open for the men in the evenings.

An outfit for a gang of foreign laborers, or for a gang of native common labor, would be made up of substantially the same equipment.

As a sanitary measure, foremen should be held responsible for the condition of their cars, and periodical inspection should be made to see that they are kept in

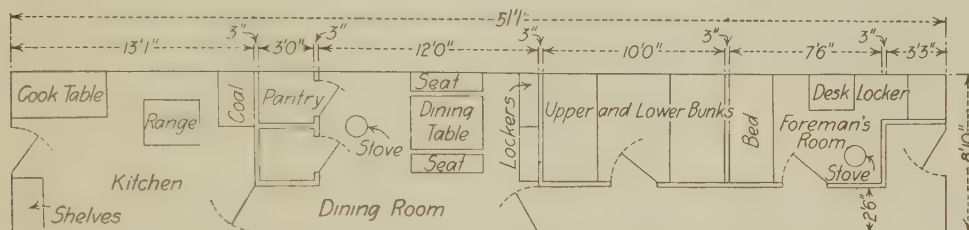


FIG. 3—FOR FOREMAN AND COOK, COLORED EXTRA GANG

good condition. Disinfectants and insecticides should be furnished by the railroad company, and their frequent use required.

For the sake of appearance as well as of sanitation, garbage, tin cans and other rubbish should be buried or otherwise disposed of daily. A pit for this purpose could be dug and each day's accumulation covered with a layer of dirt by the cook or flunky.

Fly screens for the whole outfit may seem a little too much to suggest at the present time, but as a preventive of disease, the cook and dining cars at least should be well screened.

Permanent toilets in or with the cars are of course out of the question, but where the camp is to be located at one point for any length of time, a ditch-and-timber of the army type, with a screen of canvas or other material, will save numerous complaints from the railroad's neighbors, and will prevent the use of depot toilets by the men. If such a ditch is used, it should be the duty of the camp flunky or some one of the laborers to see that a layer of dirt is placed in the ditch each day. This will practically eliminate the odor and will limit the disease-carrying activities of flies.

To some of the old-timers these suggestions may seem like making it too "soft" for the men. But conditions have changed, men have changed, and ideals have changed. The railroads owe something to the health and comfort of their men. The men are demanding it, possibly not directly, but by seeking employment elsewhere; and from the viewpoint of sanitation we cannot afford to allow conditions to exist that endanger the health of the man and, through them, that of their families and the public.

Engineers Guide Sewage-Disposal Inspection Trip

Decatur Decides to Hire a Consulting Engineer—Finds Lime Plants Being Abandoned, Activated Sludge Expensive

A PROPOS of junketing parties and their value, as discussed in the editorial, "Experts Overnight," in the Engineering Record of Nov. 18, page 607, engineers will be interested in the results of an inspection trip by Decatur (Ill.) officials, including P. T. Hicks, city engineer, and Prof. Edward Bartow, director of the State Water Survey. One recommendation made when the party reached home indicates that the opposite effect from that pictured in the editorial was happily accomplished—that "a competent consulting engineer be engaged to co-operate with the city engineer on the preparation of plans for the construction of the sewage-disposal plant."

The conclusions reached are as follows: Sand beds

and contact beds will not do, because of the large area required. Any process involving the use of lime as a precipitant will be unsuited to Decatur conditions because of the large amount of lime needed and the large amount of sludge which must be disposed of by some means. Imhoff

tanks and sprinkling filters as used in Plainfield, N. J., Fitchburg, Mass., and the Brighton plant at Rochester, N. Y., would be suitable for the domestic sewage of Decatur, and if built of sufficient size would be suitable for the combined domestic sewage and starch-factory wastes. Activated sludge might be suitable, provided power can be obtained for less than 1 cent per kilowatt-hour, and some satisfactory method of dewatering the sludge or disposing of it can be found.

Other recommendations call on the city engineer to prepare plans for an interceptor to carry the sewage to a suitable site for a disposal plant, that he prepare plans for the plant, assisted by a consulting engineer, and that the Illinois State Water Survey be asked to co-operate in any way possible.

The party visited plants at Columbus, Ohio, Brooklyn and Rochester, N. Y., Chatham, Morristown and Plainfield, N. J., Providence, R. I., Worcester, Fitchburg, Norwood and Walpole, Mass., and Cleveland. Extracts from the report are given to indicate in what operating condition some of the plants were found, and what the party concluded with reference to home conditions is inserted in reporting on each type of plant.

FIND LIME PLANTS BEING ABANDONED

A fairly satisfactory effluent having been obtained by the electrolytic lime process, and an equally good effluent having been obtained with lime alone during a short period when the electricity was shut off from the plant, it was at first thought possible that the chemical treatment as used at Canton, Ohio, Brooklyn, Worcester or Providence might be suitable for adoption at Decatur. Such did not prove to be the case. Canton abandoned

the lime treatment about a year ago and is now operating a new plant consisting of six tanks and sixteen contact beds covering 10 acres. At Brooklyn lime is used in the treatment of sewage at the Twenty-sixth ward pumping station. Sludge is spread over the low meadow lands, but plans are being made to abandon this plant and to substitute Imhoff tanks and sprinkling filters.

SETTLING TANKS AT PROVIDENCE

At Providence the sewage, after treatment with lime or with calcium hypochlorite, is settled in tanks. After settling it is stored and discharged with the ebbing tide. The effluent is only fair in quality. The cost of treatment by lime or hypochlorite was \$3.59 per 1,000,000 gal. The disposal of sludge is a difficult and expensive matter. It is first pumped by Shone ejectors to storage reservoirs, then by gravity to forcing reservoirs, from which it is forced under pressure of 60 lb. per square inch through large filter presses and finally is transported by cars to scows and carried 14 miles down the bay. The cost of sludge disposal in 1915 was \$3.01 per ton of dry solids. The superintendent, Mr. Bugby, stated that he thought the Providence plant, in service since 1901, would be the last of its kind. Experiments with activated sludge were being tried, but had not proceeded far enough to give conclusive results.

CHEMICAL TREATMENT AT WORCESTER

At Worcester during 1915 not quite two-thirds of the sewage was treated chemically. The remainder, the strongest part of the sewage, was treated on sand beds. One thousand and forty-eight pounds of lime was used per 1,000,000 gal. The sewage, after treatment with lime and thoroughly mixed, passed into six roughing tanks and afterward into ten finishing basins. The sludge is drained by gravity to a sludge well, from which it is pumped by a Shone ejector into two storage basins. The sludge presses did not have sufficient capacity to press all of the sludge and part of it was disposed of on old sludge beds. The remainder, after filter pressing, was carried on cars by trolley motor to a sludge dump, from which a considerable portion is removed by the farmers each winter. The cost of chemical precipitation was \$5.29 per 1,000,000 gal., and pressing was \$4.93 per 1,000,000 gal. During 1914 experiments were made with Imhoff tanks and sprinkling filters, with a view to their adoption either in enlarging the plant or in replacing chemical precipitation and sand filtration. The Worcester plant has been in operation since 1890.

NORWOOD'S TANNERY

At a tannery at Norwood was a waste more nearly resembling the starch-factory waste at Decatur than any sewage seen. A waste of 500,000 gal. several times as strong as ordinary domestic sewage is treated with sufficient lime to make it alkaline. After passing through settling tanks a portion of the effluent is applied to sand beds. The remainder is treated by dilution with water from an 800,000,000-gal. reservoir. When dilution water is too low it is oxidized by sodium nitrate. The sludge is transferred to drying beds. Part is carried off by the farmers, but part must be carted away by the owners of the tannery. The cost of the plant was \$100,000 and the annual net cost

\$30,000. This cost is considered excessive, and experiments have been carried on with Imhoff tanks and sprinkling filters. These tests show that a plant to handle the waste satisfactorily can be constructed for \$63,480. Preliminary experiments with activated sludge give sufficient encouragement to warrant their continuance on a larger scale.

The most difficult part of the operation of the lime-treatment plants was sludge disposal. Owing to the fact that the Decatur sewage would require approximately 3000 lb. of lime per 1,000,000 gal., there would be a much larger proportion of sludge to be removed than at either Providence or Worcester. Owing to the large amount of lime required, the fertilizer value would be less than at Providence or Worcester. The fertilizer value at either place is not sufficient to afford any income from the sludge. Rather it is an expense to dispose of it.

SCREENING ONLY AN AUXILIARY

Reinsch-Wurl screens were seen in operation at the Twenty-sixth ward station at Brooklyn. At the time of the visit, Saturday afternoon, the sewage was very weak and only a very small amount of suspended matter was being removed. The effluent from the screens, after passing sprinkling filters, was stable. Reinsch-Wurl screens were being installed at Rochester to remove the coarser suspended matter before the sewage entered the tanks. Each 12-ft. screen cost \$13,000 in place. At one of the stations in Cleveland not visited by the commissioners, Reinsch-Wurl screens were in use, but the proportion of suspended matter removed is very slight.

Observations would indicate that screening alone would not be suitable for Decatur conditions, but that it might be used to remove suspended matter should some form of tank treatment be adopted for the Decatur disposal plant.

TANK TREATMENT TENDS TOWARD IMHOFF STYLE

Septic tanks are being abandoned for the more modern Imhoff septic tanks. At Plainfield the old plant contains septic tanks which will be abandoned before the close of the present year. At Morristown septic tanks are still in use as preliminary treatment to contact beds, but this type is no longer to be recommended. The Imhoff tanks at Columbus are only partially completed. All of the sewage of the city was passed through ten tanks, which were greatly overworked, and which, because of the failure to complete the connection to the sludge-drying beds, contained too much sludge. The sludge had risen over the top of the gas vents and nearly covered the surface of the tanks. At Chatham, Imhoff tanks were used for the preliminary treatment before contact beds. The effluent, however, was not stable and could not be discharged into a small stream without further treatment. The sludge from the tanks was being dried satisfactorily on sludge beds. At Fitchburg five tanks have been in use about two years. The operation is satisfactory in preparing the sewage for distribution on sprinkling filters. The operation of the plant is good. At Rochester the Brighton plant, which contains tanks for preliminary treatment before sprinkling filters, was furnishing a satisfactory effluent for disposal on the

sprinkling filters at the time of the visit. This plant and the plants at Fitchburg and Plainfield are good illustrations of the best modern sewage-disposal practice.

Owing to the necessity for emptying Decatur sewage into the Sangamon River, which is practically dry during a considerable portion of the year, the tanks alone, which do not furnish a stable effluent, would require additional treatment by dilution or by secondary treatment.

SPRINKLING FILTER SIZE IMPORTANT

Sprinkling or trickling filters have a capacity about twice as great as contact beds and furnish an effluent as satisfactory. The size of filters required varies with the strength of the sewage. The plant at Columbus, where sprinkling filters followed septic tanks, was not entirely satisfactory. It is expected that when the new Imhoff tanks are entirely completed satisfactory results will be obtained.

The new plant at Plainfield is not yet in operation, but it is expected that it will give satisfactory results with the domestic sewage. The effluent of sprinkling filters at Fitchburg, after passing through a secondary settling tank, is uniformly stable.

With secondary settling tanks a very clear, stable effluent was obtained at the Brighton plant at Rochester.

EXPERIMENTAL PLANT AT NORWOOD

An experimental plant at a tannery at Norwood has shown that sprinkling filters following Imhoff tanks would take care of tannery wastes at a rate of 500,000 gal. per acre per day.

The Imhoff tanks and sprinkling filters followed by secondary sedimentation would be suitable for Decatur conditions, states the report. Because of the starch-factory wastes it will be necessary to furnish a larger area of beds than would be necessary for domestic sewage alone. Probably an area of beds between that used at Plainfield, Fitchburg and Rochester and less than that used in the experimental plant at the tannery at Norwood would be needed. It seems unfortunate that experimental tests at Decatur could not have been carried out when the starch factory was in operation, so that the efficiency of tanks and filters in treating the mixed starch-factory wastes and domestic sewage could be determined.

SAND-FILTER EFFLUENTS GOOD

Very satisfactory effluents can be obtained from sand filters. These were seen at Chatham, following Imhoff tanks and contact beds; at Morristown, following septic tanks and contact beds, and at Worcester, following settling tanks. Sand beds are also used at Walpole for the treatment of part of the waste from a paper mill, and at Norwood for part of the waste from the tannery.

Because of the large area that would be required for the domestic sewage at Decatur, and owing to the absence of sand deposits in the neighborhood, treatment of Decatur sewage on sand beds seems impractical.

At Brooklyn experiments with activated sludge have given promising results. The process will be studied with a view to its possible adoption at Coney Island and Rockaway.

At Providence an experimental plant was seen in which it is proposed to determine whether it would be practical to replace the chemical precipitating tanks by the activated-sludge process. It is thought that the present chemical tanks could be modified into activated-sludge tanks if the process proves economical.

At Norwood preliminary experiments have been completed with sufficient promise to warrant a continuance of the experiment. Either activated-sludge or Imhoff tanks with sprinkling filters will be adopted for a new disposal plant at the tannery.

ACTIVATED-SLUDGE PROCESS

At Cleveland 500,000 gal. of sewage is being treated daily by the activated-sludge process in a tank only 20 x 60 x 14 ft. deep. No attempt is made to obtain a perfectly stable effluent. Owing to the dilution in Lake Erie, an effluent which is stable for two days is considered satisfactory. The cost of air for the treatment at Cleveland is stated to be \$3.75 per 1,000,000 gal. with air at 0.75 cent per kilowatt-hour.

If the city of Decatur can obtain power for less than 1 cent per kilowatt-hour, and if an effluent containing no suspended matter that would be stable for two days would meet the requirements of the Rivers and Lakes Commission, it would seem as though the activated-sludge process might be considered for the disposal of Decatur city sewage. This seems especially suitable for Decatur conditions, owing to the presence of the starch-factory waste. This waste has a concentration of from five to ten times that of domestic sewage and an organic content approximating the packing-house wastes of Chicago, for the disposal of which activated sludge has been recommended.

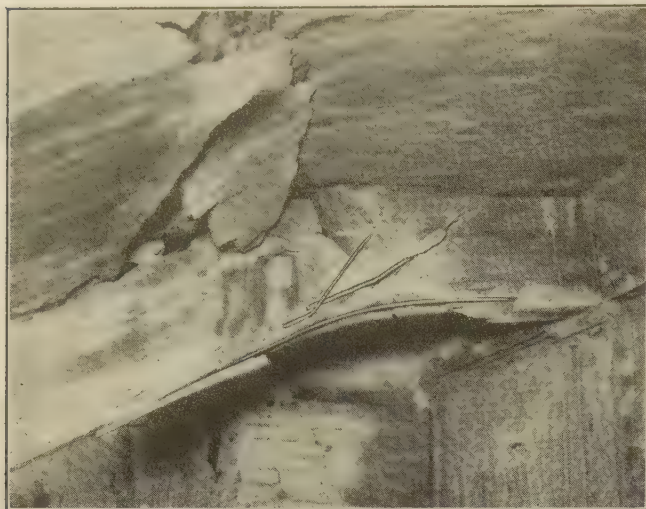
DISPOSAL OF SURPLUS SLUDGE

The problem of disposal of surplus sludge from the activated-sludge process has not yet been satisfactorily solved. At Brooklyn it is proposed to aerate and settle and decast the supernatant liquid, repeating this process until only humus remains. At Cleveland the disposal by the centrifuge used in laundries has not been found satisfactory. Disposal on sand beds under cover, after continuous aeration of the sludge for several days, has been found possible, but further experimental work is desired before it can be declared practical. Experimental work on sludge disposal is being carried out at Chicago, Milwaukee and at the University of Illinois. Therefore more definite information should be at hand at an early date.

S. A. Greeley and Langdon Pearse, the consulting engineers who made the original experiments at Decatur, have been re-employed to assist Mr. Hicks, city engineer, on the interceptor and the general problems as they develop.

Economy Forces Paving of Fords in Arizona Over Washes

Fords over shallow washes in Arizona to obviate a high-grade line and to reduce the expense of bridges are made of 8 and 10-in. rock laid by hand and grouted in with cement mortar. A 2-in. wearing surface of concrete is placed on top. Curtain walls extend below the paving to prevent scour.



EXPOSED STEEL IN BEAM OF FOURTH FLOOR WHICH FAILED

Quartz-Gravel Aggregate Blamed for Excessive Fire Damage

Reinforced-Concrete Warehouse Fire at Far Rockaway, N. Y., Investigated by Ira H. Woolson—Fire Enters at Small Holes

AFTER a thorough investigation of the excessive damage to the structural framework of a reinforced-concrete warehouse caused by a relatively low-temperature fire on Nov. 10, 1916, Ira H. Woolson, consulting engineer to the committee on construction of buildings of the National Board of Fire Underwriters, has just issued a 31-page pamphlet in which he concludes that the principal cause of the damage can be traced to the use of pure quartz-gravel aggregate. Previous tests of similar concrete are cited to show that disintegration at comparatively low temperatures may be caused by the relatively high coefficient of expansion of quartz, and more complete investigation is called for. In proportion to the probable intensity of the fire, the damage greatly exceeded the memorable Edison fire reported in the issue of Dec. 19, 1914, page 660, for which methods of repair were described in subsequent issues. The following abstract of Mr. Woolson's report includes the principal lessons from the spread of the fire and the striking conclusions in which explanation of the excessive damage from minor short flash fires is offered.

FIRE SPREADS THROUGH SMALL HOLES

The fire started in a three-story frame woodworking shop, which was entirely destroyed, and was transmitted to the contents of the adjoining seven-story reinforced-concrete building on White Street, Far Rockaway, owned and operated by Mullen & Buckley and used for furniture storage and repair and for light manufacturing—window screens, chair seats, etc. The fire evidently spread to the inflammable contents of the warehouse through very small holes in the 8-in. concrete wall—in the first floor through a 5-in. hole used for a tube of an interior carrier system and through a 1-in. hole in the west end to a pile of kindling wood, starting a light surface fire; in the second floor probably through $\frac{1}{2}$ -in. openings around a poorly fitting fire-door; in the fourth floor through a 1-in. hole or around

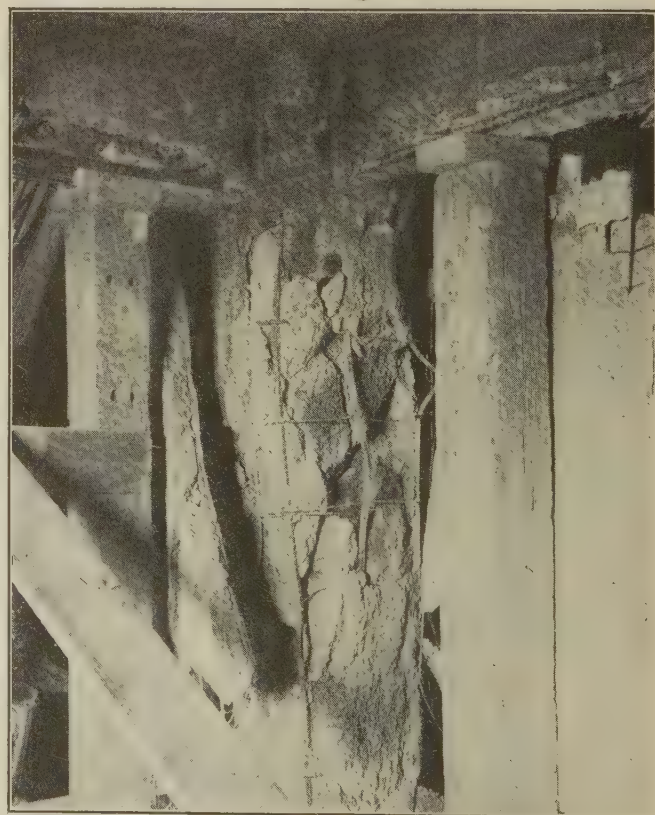
a brick wall, and in other upper floors possibly through fused glass of the windows.

The concrete building, 52 x 90 ft. in plan, was of girder, beam and slab construction, with one row of square columns down the center, giving panels about $17\frac{1}{2}$ x 26 ft. The design was made by the Trussed Concrete Steel Company and the building was erected in 1909 by the Industrial Engineering Company. A mix of 1:2:4 stone concrete was specified and quartz-gravel aggregate generally 1 in. in size was used, but some $2\frac{1}{2}$ -in. stone were found in the damaged structure. The columns are reinforced by vertical rods and round ties on 12-in. centers, with concrete protection varying from $1\frac{1}{2}$ to 3 in. Floor slabs varied from 4 to 6 in. in thickness, with an upper surface finish $1\frac{1}{2}$ to 2 in. thick cast subsequently, which separated when the floors deflected. Expanded rib reinforcement with 4-in. mesh was used for these slabs in sheets 32 in. wide, with spaces 2 to 4 in. between sheets, and little concrete protection was furnished the steel—generally only $\frac{1}{8}$ to $\frac{1}{4}$ in.

Girders and beams were reinforced by Kahn trussed bars. In the part of the fourth floor which failed, the negative reinforcement for the beams was near the bottom instead of the top of the floor slab, and in both girders and beams it was found that the ribbed bars sometimes touched each other, instead of being spaced properly. Concrete $\frac{1}{2}$ to $1\frac{1}{2}$ in. thick protected the bars.

RESULTS OF THE FIRE

The pamphlet contains an exhaustive discussion of the results of the various fires on each floor of the concrete building—their nature and the effect on the con-



INTERIOR COLUMN FAILED AND UPPER FLOORS SETTLED

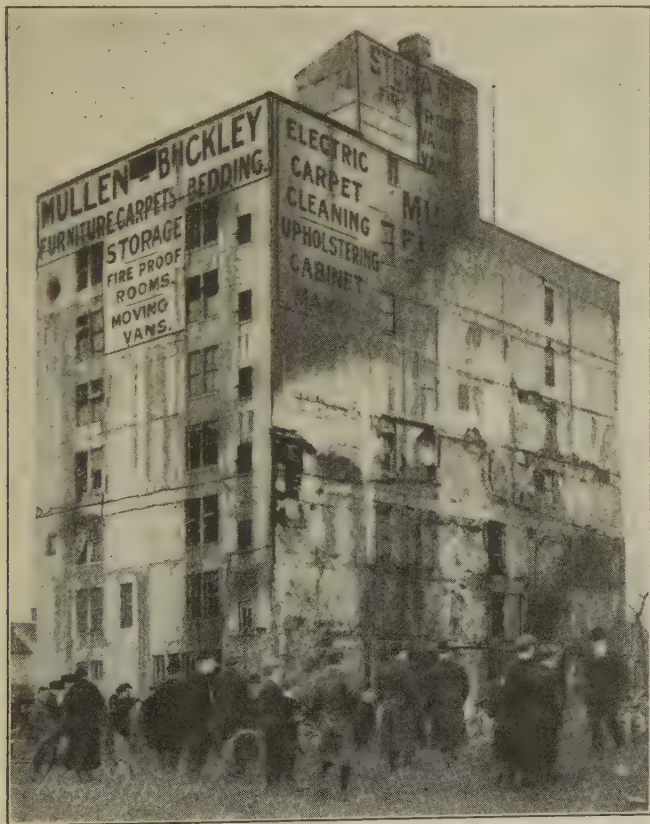
Located near the rear of third floor. This column was subjected to high temperature from burning oil in the vicinity.

crete. Striking evidence is presented of large structural damage due to minor short flash fires, in addition to the complete failure of the fourth-floor slab and one column in the rear in the vicinity of the hot fire caused by six or eight barrels of inflammable liquids stored in an oil and varnish room at the northwest corner. Melted copper and brass in this vicinity indicate temperatures from 1600 to 2000 deg. Fahr. An interior column, shown in one of the photographs, was completely shattered and failed by diagonal shear, with bulging of the reinforcement. Three overhead beams fell, carrying with them the adjacent floor slab of three panels near this corner. The slab broke away from the collapsed beams and hung in separate sections, caused by lack of overlap of the slab reinforcement, the sheets of which were not wired together as specified in the design. The collapse did not occur until some time after the fire was extinguished.

FLOOR SLABS NOT BADLY DAMAGED

Aside from numerous cracks, the floor slabs throughout the building are not badly damaged, although the steel was poorly protected by concrete. The cracks contributed largely to the water damage, and their appearance indicates that a fair proportion may have existed for some time before the fire. The many cases where minor fires occurred (the work of firemen evidently being effective) a relatively large amount of spalling and disintegration of the concrete was evident. For example, in the first floor chunks 8 and 10 in. thick fell from a girder, and bars in the bottom were exposed for 15 ft. in length.

The exposed south wall, subjected to the full force of the fire in the woodworking factory, is badly spalled;



SOUTHWEST CORNER—VIEW SHOWS SPALLED CONCRETE ON SIDE AND CRACKS IN WEST SIDE



REAR PANELS OF FOURTH-FLOOR SLAB FAILED

Exposed steel and unburned timber are characteristics of this fire

spots several square feet in area and 2 to 3 in. deep are seen, but no reinforcement was exposed, as it was probably placed near the inner surface of the wall. The wall is wavy at the fourth and fifth stories and several noticeable cracks are seen. The west wall is bulged outward 1 in. or more and there are numerous cracks, one of which zigzags completely across the building at about the fourth floor level.

GENERAL CONCLUSIONS

The important conclusions from a study of this fire given in the report in addition to the first, which emphasizes the fact that a suitable sprinkler system would have saved the building, are the folly of erecting high-grade fire-resistive structures and then allowing small unprotected openings in walls and floors which permit inflammable contents to catch fire, and the deficient concrete protection for steel involved in the use of pure quartz-gravel aggregate which disintegrates under heat.

In this conclusion reference is made to the author's investigation on thermal conductivity of concrete and the final report in the *Proceedings* of the American Society for Testing Materials for 1907. Experiments are cited to show disintegration of quartz-gravel concrete under relatively low fire temperatures, probably due to the large cubical coefficient of expansion of quartz (about twice that of feldspar), and the conclusion is quoted "that the gravel concrete was not a reliable or safe fire-resisting aggregate"—a restriction which applied only to pure quartz gravel such as is found in the vicinity of New York City, similar to that used in this building. It is stated that subsequent investigations by the British Fire Prevention Committee of England confirmed these findings for a similar quartz gravel there.

If this explanation is correct, it is stated that all concrete specifications should contain a definite warning against the use of quartz gravel in concrete liable to be exposed to high heat.

Among other final conclusions are emphasized the advantages of fire-resistive partitions (even pine-board partitions prevented this fire from spreading in two cases), the destructive action of quick fires on structural members with sharp corners, such as square columns, the prevention of water damage by using water-proofed floors, and the fact that storage of inflammable liquids inside a building should never be permitted.

Volcanic Heat Drives Electric-Power Plant in Italy

Utilization of Steam Jets Issuing from Ground in Developing 15,000 Horsepower Has Overcome Scarcity of Coal

VOLCANIC HEAT is now being used successfully in the development of 15,000 hp. near Larderello, a village in Tuscany, Italy. The first of three 3000-kw. groups of turbo-electric engines driven by steam issuing from the earth's interior was put into service in January, 1916, the second in April and the third this fall. The power is transmitted electrically to Florence, Leghorn and numerous other cities and towns in Tuscany, supplying industries that had been crippled since the war by the scarcity and high price of coal.

Near Volterra, in central Tuscany, there are numerous cracks in the ground, from which powerful jets of very hot steam spout high in the air with great violence and constancy, bringing up boric acid and other substances of less importance. These jets have been utilized for many years in the production of boric acid and borax, and occasionally for warming houses in the near-by village of Larderello. Most of the steam, however, was lost.

FIRST USE OF VOLCANIC STEAM

The first use of this superheated steam for the production of motive power was made in 1903. Prince Ginori-Conti, president of the Societa Boracifera di Larderello, first applied a strong jet to a small rotary motor, then to a small reciprocating steam engine connected to a dynamo, which generated enough current to light part of the borax works.

Meanwhile, to get a more ample supply of steam he bored holes in the ground to the source of the steam, which is under a hard stratum of rock from 300 to 500 ft. below the surface. The holes vary from 12 to 20 in. in diameter, and are lined with iron pipes. They give forth steam at a pressure of from 2 to 3 and occasionally up to 5 atmospheres, and temperatures varying from 150 to 190 deg. C. These jets have not diminished in their activity, and new borings do not interfere with the preceding ones provided they are at least 50 ft. apart.

APPLICATION TO STEAM ENGINE

In 1906 Prince Ginori-Conti applied the steam to an ordinary steam engine of about 40 hp. The salts and gases were found to be very destructive of the iron parts of the engine, but this difficulty was avoided by applying the superheated steam to a boiler in place of fuel. In this way, a 300-hp. condensing steam turbine was made to supply the works and villages around Larderello.

After the outbreak of the war coal became very scarce and prices became prohibitive. Prince Ginori-Conti determined, therefore, to try a much more extensive use of the natural steam. Three groups of condensing turbo-electric engines were installed, each of 3000 kw., working with superheated steam at $1\frac{1}{2}$ atmospheres, generated in specially constructed multi-tubular boilers. As in the earlier installation, the natural steam is used instead of fuel. In heating the boiler it is re-

duced from 180. to 120 deg. C., and is then utilized for the borax industries. The steam for the boilers and turbines is ordinary water steam, which on its way to the turbine passes in pipes through superheated natural steam, thereby itself becoming superheated to about 150 deg. C. After working in the turbines the water steam is condensed and returned to the boilers.

The triphase electric current is generated at 6500 volts, transformed to 36,000 volts and delivered to Florence, Leghorn, Volterra, Grosseto and many smaller towns of Tuscany, where it is used mainly as motive power for munition works during the day time and for lighting at night.

As the region of the steam jets extends for many square miles around Larderello it is believed that the transforming of volcanic heat into electric power can be increased to hundreds of thousands of horsepower.

The foregoing information was furnished by Prof. Luigi Luigi of the University of Rome, president of the Italian Society of Civil Engineers.

Five New Piers for San Francisco This Year

Construction Program for 1917 Is Announced by State Harbor Board—At Least Four of the Piers Will Be All Concrete

THE construction program for 1917 as recently announced by J. J. Dwyer, president of the Board of State Harbor Commissioners of California, includes five new piers ranging in width from 138 ft. to 200 ft. and from 550 ft. to 800 ft. in length. Four of these will be of all-concrete construction and the fifth is still under consideration by the chief engineer.

A distinctly new phase of improvement will be the pavement of a 30-ft. strip for the entire length of the waterfront under the jurisdiction of the commission. This will be especially for the use of automobiles and light vehicles of all kinds. The pavement will be of the most durable construction—a 6-in. concrete base surfaced with a 3-in. asphaltic top dressing. The basalt pavement on the remaining width of the street will be left undisturbed.

IMPROVEMENT OF CHINA BASIN

Surveys are now under way for the improvement of China Basin, where bulkheads, wharves and piers are contemplated. This work, which is now in the preliminary survey stage, involves an improvement of the shore line between Channel Street and Pier 54. Designs are to be completed in the spring and work well advanced during 1917. At various points along the waterfront an unusually large number of buildings are to be constructed this year, including structures on shore and on piers. The commission has now established the policy of having the design of all structures prepared by the architect. This assures a pleasing and harmonious general appearance of the harbor works without any material cost increase.

The five piers will cost a total of between \$2,000,000 and \$3,000,000. All the work will be designed and carried out under the direction of Frank G. White, chief engineer of the State Harbor Commission.

On the Mexican Border with the 22d Engineers

Part II—Damage to Rain-Soaked Earth Roads by Heavy Motor Traffic Repaired —65 Square Miles of Territory Mapped—Possibilities in Use of Equipment

By C. E. BREGENZER

First Lieutenant, 22d New York Engineers, N. G. U. S.

TEXAS roads in the vicinity of the military camps at the border are of earth, indifferently crowned and ditched. They were sufficient for the light vehicles which were in use, but the advent of the troops with their equipment, and particularly the heavy motor trucks, together with the rainy season, soon caused rutting, soft holes, and wear. Prior to the arrival of the troops it had not rained for fourteen months.

RAIN AND TRAFFIC DAMAGE ROADS

The worst road conditions were naturally encountered between the quartermaster's depot, located near the McAllen freight station, and the various camps. The road leading from Pharr through McAllen to Mission was also in bad shape. While most of the roads were hub deep in many spots during the greater part of the rainy season, the lower valley points were submerged. It became necessary to make detours through the fields. A contractor who had a scraper outfit was employed to fill in the low spots and grade that part of the Hidalgo road, from the McAllen-Mission road, which led to the Squadron A camp. Traffic on these roads was very heavy, as the various outfits, particularly those having stock, had to make frequent trips to the quartermaster's depot for supplies.

An observation of the action of rain and the condition of the roads seemed to dictate the necessity of high crowns and ample ditches to insure quick runoff of water and ditch capacity to handle it. Observation of roads at summit points apparently confirmed this, and consequently this was the method followed in construction. Crowns were made 1 ft. high, and the ditches averaged from 1 to 3 ft. The bad feature of this construction is that it confines traffic to the center of the road. The ditches were plowed and the excavated soil was taken to the center of the road with Fresno scrapers, and was then surfaced after a manner. No rollers were used. This helped to make roads better in a degree, but the motor trucks soon succeeded in churning holes, especially when they used tire chains. Used after rains, the earth surface seemed to lose all bond and simply degenerated into slush.

ROAD SURFACES

Roads subjected to such heavy traffic require a base and a metalled surface. A report advocating the use of Sam Fordyce gravel for surfacing was made to the U. S. engineer officer in charge of the Brownsville district, and 10,000 cu. yd. was shipped. This was employed largely on one of the much-used regimental thoroughfares. It was spread to a depth of about 2 in., and was well watered down by providential rains. This proved a considerable improvement. It remained a matter of speculation among the engineer officers if it would not have been more profitable to run railroad spurs into the various camps, or at least industrial railroads, especially as liberty could have been used on

gradients, for the trains would not have exceeded three or four cars at a time. Military engineering practice in Europe would seem to substantiate this method of handling supplies.

The road work done by the engineers was necessarily confined to repair work. There were many exceptionally bad spots which required immediate attention. Pick-and-shovel equipment does not offer a large range



MORE THAN 1,000,000 FEET OF LUMBER WAS USED FOR STRUCTURES

on road work. Most of these repair jobs consisted of bad soft spots where vehicles and motor trucks were constantly mired. A detail of engineers dug one of these out. It was 5 ft. deep, 8 ft. wide, and 15 ft. long. When the apparent bottom was reached it developed that water was seeping in from a neighboring irrigation canal which was diked at this point. To aggravate matters, the ditches were full of water, and there was no possible point to drain to. Repairs on this road were accomplished by building a corduroy section over the freshly filled hole and topping off with fresh earth. The ditches were extended up a near-by cross-road and deepened. The whole road was raised about 3 ft. and rolled down by a roller improvised from a 3 x 6-ft. wooden cable drum filled with earth. The corduroy method was resorted to on other occasions where quick repairs were necessary.

The addition of a topographical engineer officer, under the new table of organization for engineer regiments, and the addition of master engineer sergeants,

attached to regimental and battalion staffs, gave the work of map-making considerable impetus. A complete military topographical map, showing all data required for tactical purposes, and comprising an area of 65 square miles, was completed. At the present writing this has been extended some 20 miles west of McAllen, as far as Los Ebanos, the whole making a collection of valuable data. Roads were used as controls, which in turn formed base lines for development. The roads in this section are practically all located on meridians



A COMPLETE SYSTEM OF MODERN TRENCHES WAS FIRST TRACED WITH TAPE AND THEN DUG

and parallels, which facilitated the work to a degree. One of the mess shacks was fitted up as an engineer office, and here all drafting, zincograph reproduction, blueprinting and photographic work was carried on. Most of the maps were made with the military plane-table, although in some cases compass, transits, regular plane-tables and cavalry sketching cases were resorted to. Many of the men qualified in this important branch of military engineering.

In addition to topographical maps, drawings were also made showing source of water supply, pipe lines, valves, connections and fittings for every camp in the entire New York Division. At the time of the outbreak of paratyphoid, special maps giving all camp details were furnished, and an engineer soldier was attached to headquarters on the medical staff for progress work. Engineer soldiers on the march, on finding new or unmapped roads, strapped an odometer on the wheels of an escort wagon and took bearings with a compass.

TRENCH WORK

A complete system of modern trenches was traced and constructed in a field adjoining the engineer camp. The dimensions were of a size to accommodate one company. The first-line trenches were mostly of the one-squad traverse type, and were connected by communicating trenches to dressing stations, bombproofs, latrines, overhead shelters, and other features dictated by most modern practice. The execution of this work was the daily engineer drill of such engineer troops as were not otherwise detailed. The men, besides familiarizing themselves with the various types, were also instructed in the proper use of tools.

In front of the trenches a complete system of barbed-wire entanglements was constructed, together with other types of obstacles. A trip wire system was also installed to prevent night surprises and attacks. On approaching the entanglements the enemy could not avoid contact with the wire, which automatically released a device, which in turn exploded flares provided with reflectors, outlining all approaching in strong silhouette, and bringing them under direct field of fire of the trenches. Mortars were also constructed having a sector of from 40 to 60 deg., from which illuminating bombs were fired which lighted up the entire field. Several night maneuvers proved the success of this work.

The entire system of defense was used as a school of instruction for members of the various infantry units, who attended lectures by engineer officers and were taught how to trace and dig trenches efficiently.

STRUCTURES

At the time the writer left the border (Oct. 12) it was estimated that more than 1,000,000 ft. of lumber had been used in structures for the various units located at McAllen. This included the buildings for the base hospital, mess shacks, quartermaster's storehouses, showers, regimental supply houses, tent floors, and tables and benches. Plans were United States standards furnished by the quartermaster's department at Fort Sam Houston, San Antonio. An engineer officer, with title of construction engineer, was detailed to headquarters on this work, to make estimates on materials of construction and also allotments of lumber to the various regiments. The man appointed to this office was a prominent New York engineering contractor, and so closely did he estimate that the cooks had little left for kindling wood. The various structures were built by contract, or by the men from the various units, under the supervision of an inspector furnished by the engineers.

MESS SHACKS

The greatest comfort accrued to the men from the mess shacks, which were 20 x 64 ft., with a 16 x 20-ft. kitchen on one end. In type they were very similar to contractors' shacks used on construction work, only the walls were screened entirely. The roof was of $\frac{7}{8}$ -in. shiplap, covered with roofing paper and supported by a Warren roof truss. The construction of these structures gave the men considerable experience in the use of tools.



SLUICE GATE BUILT BY ENGINEERS

Of sanitary measures there were many, but the enviable health record easily justified them. One of the most important of these was the incinerator for destroying kitchen refuse. For the construction of this the quartermaster's department furnished brick, cement, sand, a Sibley stove, and steel pan. The ordinary method of construction was to build two walls, two bricks thick, 15 ft.

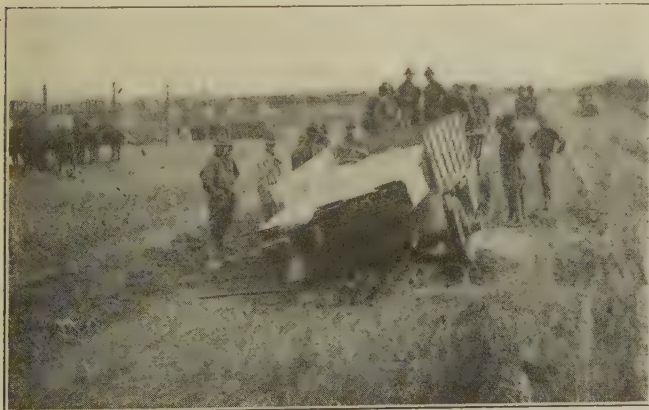
long, 3 ft. wide, and about 2 ft. high, with a 2 ft. chimney on one end, topped off with the Sibley stove for a stack. The steel pan, used for liquids, was placed over the walls and a fire lighted underneath. The solids were thrown on the fire. The government furnished mesquite wood. This type was so voracious of wood that the cooks began complaining about shortage.

Experiments were then made by the engineers, the basis of which was furnished by boiler-furnace construction. An ashpit and firebox, with pipes for grates, were constructed on one end, and the air space was reduced to 6 in. under the pan by means of a brick baffle and earth filling. Over the firebox grate another pipe grate was constructed, upon which solids were deposited. This type reduced the consumption of wood 75 per cent, and the incineration of the offal of one mess was accomplished in two hours. To prevent carbonizing of the pans, screened frames were placed over them, allowing nothing but liquids to go through. Some very artistic brickwork was secured on these incinerators. A bricklayer was discovered among the engineers who had done work of so fine a character that he laid only eighty brick a day.

SLUICE GATE REPLACED

Seeking after comfort is one of the unwritten laws of the soldier, and in pursuit of it sluiceways and water gates on a neighboring ranch suffered, according to claims by the owner. At all events, the engineers were ordered to rebuild them. The sluiceways were 4 x 6 x 18 ft., with a side outlet 4 x 6 x 7 ft., requiring two gates 4 x 6 ft. This was a good example of a military engineer working with materials at hand, for nothing was available but 1 x 10-in. by 16-ft. sheathing and 2 x 4-in. lumber. The walls were rebuilt of the sheathing, nailed to 4 x 4-in. studs and liberally braced. The gates were built of the 1-in. material, but to withstand pressure they were stiffened by cleats and 2 x 4-in. ribbing set on edge. A mechanical hoisting device was constructed by making a 6-in. diameter drum, which was operated by three 2½-ft. handles on each side, and fastened to one side of the 2 x 4-in. standards. By this means the gates were raised without difficulty, and the owner was satisfied.

In addition to the engineer work described, the engineer troops were obliged to perform infantry drill, do guard duty, participate in reviews, and follow closely the curriculum prescribed for infantry soldiers. The



EARTH ROADS, SATURATED BY RAIN AND SUBJECTED TO HEAVY MOTOR-TRUCK TRAFFIC, SOON REQUIRED REPAIRS

officers and a mounted section from each company were also required to do cavalry drill. To defend what he has constructed the engineer soldier must also be a good shot.

ORGANIZATION AND EQUIPMENT

Under the new table of organization an engineer regiment consists of two battalions, of three companies each, with a colonel, lieutenant-colonel, two majors, three adjutants, one supply officer, a topographical engineer offi-



A COMPLETE TOPOGRAPHICAL MAP WAS MADE COVERING AN AREA OF 65 SQUARE MILES

cer, six captains, twelve first and six second lieutenants for company officers. The new grades of senior and junior master engineer sergeants have also been established. Among the officers who served with the 22d New York Engineers on the Mexican border were two West Point graduates who had served with engineers, three who had participated in the Philippine campaigns, and civil engineers who had worked in Mexico, India, and other tropical and semi-tropical climates.

COMBAT TRAIN

The combat train referred to in this article is very similar to a contractor's tool box mounted on a wagon gear. It is rendered readily accessible by openings on the top, sides and rear. The battalion combat train contains transits, levels, plane-tables, level and stadia rods, range poles, plumb-bobs, steel and metallic tapes, drawing tables, instruments and supplies, and generally the same class of articles as go to make up a field engineer's equipment. The company combat train contains compact plane-table outfits, cavalry sketching boards, photographic outfits, drawing tables and instruments, field books and stationery, lanterns, portable acetylene lighting outfit, picks, shovels, spades, mattocks, axes, crow and pinch bars, sledge hammers, wrenches, complete set of carpenter's tools, jacks, explosives, fuse, batteries, nails, bolts, chisels, hacksaws, etc. A separate field-battery wagon for explosive work, a map-making wagon, and a zincograph outfit for rapid reproduction and multigraphing are also furnished. In addition, the regiment is equipped with escort wagons and a light advance pontoon train.

Perhaps, in the spirit of preparedness, many readers

will see a close parallel between the work of the military engineer and that of the engineering contractor. Both must be adept in the handling of men and equipment. The value in military engineering of field-construction experience, the handling and housing of men, cannot be overestimated. The engineering contractor would lean more toward the use of equipment than is common in present military practice. He would consider caterpillar tractors, trench pumps, and other portable pumps for water supply, portable compressors and drills, road machinery, portable lighting outfits and refrigerating plants, trench excavators, welding and cutting apparatus, concrete machinery, small hoists and gasoline engines and saw rigs. It may be advanced that these would militate against mobility; but they would make for time and comfort. On the mobility point the motor truck appears as a factor. It has many advantages, but the army mule is still reliable.

Present European experience seems to favor the larger use of plant and equipment for military work. If the combat train in use in this country were incorporated in a motor truck, more space would be gained, a winch could be fastened to the hubs, and a collapsible steel derrick could be added from which a small type of pile hammer could be suspended. It cannot be gainsaid that in the American engineer and engineering contractor this country has a splendid reserve, whose scope of action in time of war has probably not been fully realized.

Wisconsin Methods of Gravel-Road Construction Explained

Substantial Foundation, Careful Gravel Selection, Crushing of Oversize, Even Spreading and Early Maintenance Are Essential Features

GRAVEL roads so well constructed that they wear almost as long as macadam were described by J. T. Donaghey, chief inspector of the Wisconsin Highway Commission, in a paper presented before the Northwestern Road Congress, the source of the following notes.

Surveys, plans and cross-sections for gravel roads are the same as for other types of surfacing, and standard concrete culverts are built. The grade is made somewhat wider than necessary for the present gravel surface so as to accommodate a wider surface when traffic conditions demand it. No sod or vegetable matter is allowed under the surfaced portion. Where necessary, underdrainage is provided and just as good a foundation is insisted upon for gravel road as for any other type, since it is impossible to get a good surface on a poor foundation. The subgrade is prepared by cutting out a trench the full depth and width planned for the finished surface and having the same crown. Wide drains are constructed to insure a dry subgrade in the event of rains during the course of construction. On clay soils the subgrade is rolled before placing the material, the purpose being to develop the weak or soft spots, if any.

In building a pit-run gravel road the large stones are removed at the pit, preferably by the use of an elevator and screen. Gravel is delivered to the elevator by wheelers or Fresnos. If extreme care is used the large

stones may be removed at the time of loading by the use of five or six-time forks. The latter method is not recommended and is satisfactory only on small jobs.

Loads of exactly the same size in length, width and depth should be hauled. It is essential that they are dumped so that each covers the same length and width, insuring an even depth of material. To use uneven loads with the ordinary method of spreading is sure to result in an uneven surface.

GRAVEL ROADS BUILT IN TWO COURSES

Practically all gravel roads in Wisconsin are built in two courses plus the binder necessary, spreading the first course evenly to a loose depth of not to exceed 6 in., and generally beginning at the end nearest the pit and hauling over the material as the work progresses. This method saves some rolling.

The first course is gone over several times with a road plane or light grader, with blade set nearly at right angles, to insure an even surface before rolling. After properly rolling the first course the second course is started at the farthest end from the pit and work progresses toward it. The material is spread to a loose depth of about 5 in. and harrowed thoroughly with a heavy peg-tooth harrow before rolling. Most pits run uneven, but the harrow will tend to mix the material and will also bring the coarse stone to the surface where it can be raked off. If the gravel will not bind readily it may be necessary to harrow in clay to help in bonding, which can be done at the same operation; but care must be exercised in the application of clay, because an excessive amount may cause the surface to rut during wet weather. A light grader is used a sufficient number of times to insure the removal of all wavy appearance and give to the surface a proper crown.

SECOND GRADING OFTEN NECESSARY

It is often necessary to use the grader a second time after the rolling has been started to remove the wavy appearance. The voids in the surface, if any, are filled with fine gravel, then the road is rolled thoroughly and flushed.

Better results may sometimes be obtained by thoroughly wetting the material and allowing it to dry to such an extent before rolling that the binder will not pick up on the wheels of the roller. This method insures the proper bond from the bottom up. It is difficult to advise as to the proper amount of water for a pit-run gravel road, as no two sections can be treated alike. If possible, the road is opened to travel while the roller is yet on the job, and if ruts appear they are filled at once by using the light grader or road plane and roller until thoroughly compacted. Provisions are made for following up with maintenance immediately if necessary, as well as surface treatment when the surface becomes well cured.

CRUSH AND SCREEN LARGE SIZES

In many eastern and southern counties in Wisconsin are numerous gravel pits of excellent quality, but they usually contain a rather high percentage of large stone, and many contain an excess of binder. To handle this particular kind of gravel economically and get the very best results, it is found necessary to crush and screen it. An ordinary portable jaw crusher, with screen and

bins, having a capacity of from 80 to 120 cu. yd. per day, is used. Usually the plant is equipped with a conveyor and grizzly screen which removes the fine material and transfers it to the elevator, allowing only the coarse stone to pass through the crusher jaws. This procedure increases the capacity of the crusher from 20 to 40 per cent.

CRUSHER PLANT

The crushers are equipped with a three-compartment portable bin of 35 to 50 cu. yd. capacity and a two-section screen, each section being 30 in. in diameter and 4 ft. in length. The first, or lead, section has $\frac{1}{2}$ -in. perforations and the second section $1\frac{3}{4}$ in. perforations, thus separating the material into three sizes. The No. 1 size consists of material refusing the $\frac{1}{2}$ -in. ring; the No. 2 size the material refusing the $\frac{1}{2}$ -in. ring and passing the $1\frac{3}{4}$ -in. ring; the No. 3 size the material passing through the $\frac{1}{2}$ -in. ring. The crusher jaws are adjusted so as to produce about equal proportions of the No. 1 and the No. 2 sizes.

The subgrade is prepared as described for pit-run gravel, but construction is started at the end of the road farthest from the gravel supply. The first course consists of No. 1 material spread to a loose depth of about 6 in., and well rolled, the voids having been filled with the necessary amount of No. 3 material. This course is laid for a distance of about 400 ft. before starting the second course.

SECOND COURSE

The same care is exercised in having uniform loads delivered and evenly spread. The second course consists of about 5 in. of No. 2 material, evenly spread and rolled, the voids being well filled with No. 3 material. The surface is brought to the proper crown with a light grader and then thoroughly rolled and flushed in practically the same manner as is a stone macadam road.

Some pits contain quite a percentage of clay, and in this case a heavy harrow is used to work in the No. 3 material, thereby greatly benefiting the finished road. In some cases there is a surplus of No. 3 material which is distributed at convenient points along the road for maintenance purposes, or used for surfacing private entrances or road intersections.

GRADING OF MATERIAL

In many instances better results are obtained by crushing the gravel fine enough for practically all the material to pass through the $1\frac{3}{4}$ -in. ring. In this case it is the practice to carry over into the No. 2 material just enough of the No. 3, or bonding material, to fill the voids in the No. 2. This is accomplished by placing a sheet-iron jacket around the lower three-fourths of the first section of the screen, which does not permit all the finer material to pass through the $\frac{1}{2}$ -in. perforations but carries the necessary binder over into the bin with the No. 2 material. This must be regulated so as just to fill the voids in the No. 2 material with the No. 3, and no more. The remainder of the No. 3 material will naturally drop into the No. 3 bin and may be used in finishing the surface where additional binder is required, or for future maintenance and other purposes. By pursuing this method, both first

and second courses are built of the same sized materials, resulting in a type of road which is easier to build, cheaper to maintain and one which generally gives better satisfaction than any other type of gravel road. Where clay is used to assist in binding, or where there is naturally an excessive amount of clay in the gravel, it is advisable to place a covering of sharp sand or gravel on the finished surface to protect it until the excess clay has worked to the surface and washed off.

Just as much care is taken in finishing a gravel road as one costing three times as much, in trimming up the shoulders properly and cleaning out the ditches so the water can get entirely away from the road immediately after each rain. The last \$50 spent in an intelligent manner for shaping and trimming up any mile of road stands out more plainly than does any \$100 spent on the same road.

DO MAINTENANCE EARLY

The maintenance of Wisconsin pit-run gravel roads consists chiefly in the application of new material where necessary, shaping up the surface with a road plane or light grader, the removal of stone that may appear on the surface, and cleaning out the ditches and culverts. This work is done as early in the season as possible, one of the counties having shaped up over 50 miles during the month of April, 1916, by the use of a motor truck pulling two road planes covering a width of 18 ft. An average of 10 miles per day, including the removal of loose stone from the surface, was completed at a cost of less than \$5 per mile. When new material is added the road plane is used to even up the surface before it becomes thoroughly compacted. A cheap light oil is often used to advantage in the maintenance of this type of gravel road, but heavier oils are not advocated for the reason that the wearing surface is liable to be somewhat uneven in quality, the soft or loose spots invariably pitting out, which is anything but satisfactory.

The maintenance of the crushed-gravel roads consists in placing new material where necessary each year, a surface treatment with a good asphaltic oil or refined tar, and cleaning out all ditches and culverts.

WINTER HAULAGE REDUCES COST

It is customary when the crushing machinery is located in a gravel pit to crush an additional amount of material to be used for future maintenance. Some counties haul this material during the winter months, which generally reduces the cost to a considerable extent. It is deposited in large piles near the roadside and used as needed. The surface treatment is applied in the same manner as on a stone macadam surface. The surface is swept perfectly clean with a power sweeper, followed by hand brooms, to insure the removal of all vegetable matter and dust pockets. About 0.6 gal. of bituminous material per square yard is applied with a pressure distributor. A covering of about $\frac{1}{4}$ in. of fine gravel or torpedo sand with the bitumen forms a carpet that protects the wearing surface.

A system of patrol maintenance should follow this surface treatment, as spots are likely to appear that require an additional amount of bitumen, which if not taken care of immediately will cause holes to appear in the road surface that will be very disagreeable.

Deep Girders for Tank on New Top Floor of Chicago Building

Union League Club's Three-Story Addition Provides Gymnasium and Swimming Pool—New Columns on Special Foundations

CARRYING a swimming tank at the new eleventh-floor level and providing a gymnasium with locker rooms and other facilities, the steel framework added above the original old eight-story building of the Union League Club in Chicago contains plate girders nearly 11 ft. deep lined with cement, sheet lead, waterproofing and tile to form the walls of the tank. Other special features are the foundations, which had to be designed to avoid interference with existing column piers and carried down more than 60 ft. to rock, and the cantilever truss framing with eccentric connections to columns. The following data are taken from an address presented to the Western Society of Engineers by F. E. Brown, structural designer for Holabird & Roche, architects, of Chicago, who designed the additions and alterations.

SWIMMING TANK ON ELEVENTH FLOOR

As a large space unobstructed by columns was necessary, it was impracticable to locate the swimming tank in the present basement, and therefore three stories were added to the old building to provide the desired swimming pool and gymnasium. This old original building covers 49 ft. of the south end, or rear, of the lot, and is of skeleton construction, with steel beams and girders and cast-iron columns eight stories in height. The framing for the upper of the three new stories, or the eleventh floor, is indicated in one of the drawings, and the photograph shows the roof framing and deep plate girders which act as sides of the swimming tank.

The tank is 30 x 60 ft. in plan, and provides for a water depth of 8 ft. 6 in. at the plunge and 4 ft. at the shallow end. Directly over and covering the entire area of the swimming pool is a double skylight, the top lights on a straight pitch and the inner lights of amber glass in the form of an arch. The bottom of the tank occupies a large part of the tenth floor, while the remaining space on that floor is used for locker and dressing rooms.

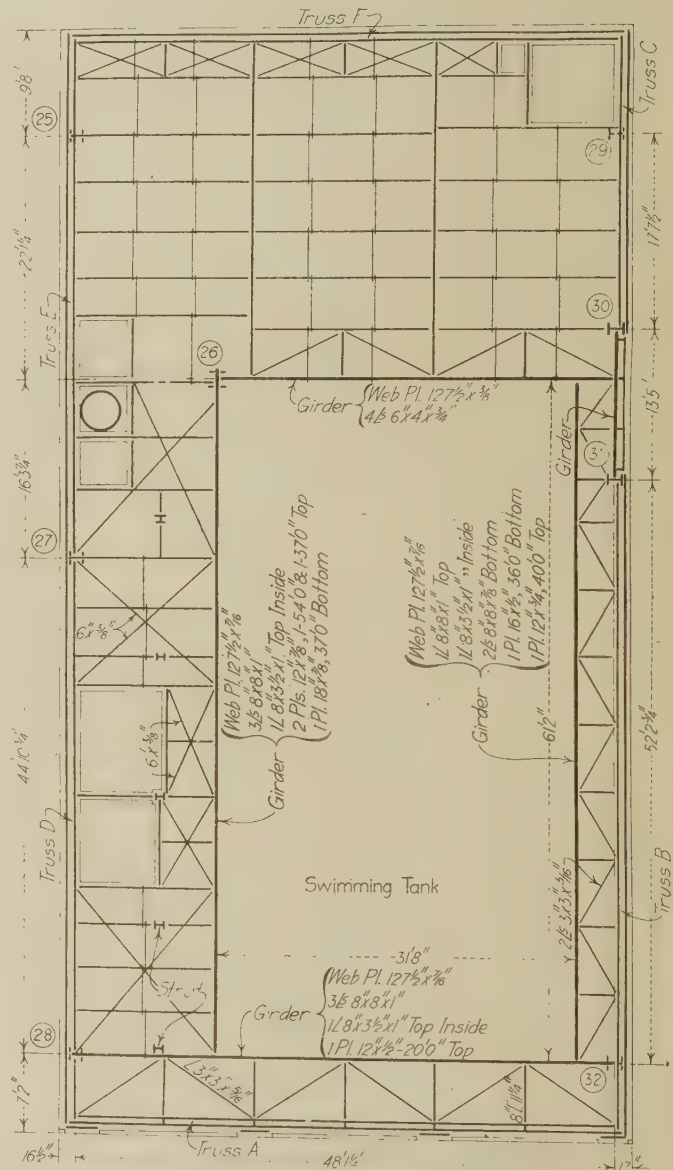
OLD COLUMNS REINFORCED—NEW FRAMEWORK

The old cast-iron columns were good for little added loading and could not be reinforced to any great extent. Furthermore, the old foundations were inadequate and could not readily be reinforced, hence replacing old columns by new steel columns was out of the question for the heavy loads of the tank floor. The old columns below the seventh floor and foundations were, however, strong enough to support the new ninth floor, as the original design was made for nine stories, six stories built permanently and the seventh as a temporary story with light columns. These light seventh-story columns had to be reinforced by filling and inclosing them with concrete, reinforced with hoops and vertical rods.

The new tenth and eleventh floors are supported independently of the old columns on eight new columns, as indicated, located to clear the old foundations and not obstruct important rooms in the old building. In only one case could a column be located at a corner of the tank or in the interior of the building, and none could

be placed in the end walls. Since seven of the new columns were located in the walls, some especially difficult cutting and reframing of old spandrels was required. In the east and west direction the old spandrel and wall beams served as braces for the new columns, but in the north and south direction new beams were added, consisting, in general, of 12-in. channels laid flat and bolted to the top flanges of the old floorbeams.

The sides of the swimming tank are plate girders nearly 11 ft. deep, with record-breaking plates 127½



FRAMING PLAN OF ELEVENTH FLOOR—LOCATION OF COLUMNS

in. wide. These girders support parts of the tenth and eleventh floors and roof and the 800,000 lb. of water. The sloping bottom of the tank is made of 18-in. I-beams spaced 13 to 24 in. apart on centers, with ⅜-in. plates riveted to the top flanges of these beams and to shelf angles on the main girders.

In the tenth story on all four sides of the building a system of trusses is used to support the walls and the floors above, and also the east and west walls of the ninth story and the adjacent ninth-floor area. As shown on the plan, some of these trusses cantilever over the new columns located 7 ft. and 10 ft. from the building lines. Truss C has such a short anchor arm that the

cantilever load causes uplift on column 30, advantage of which was taken in the design of the column. Secondary stresses were investigated and found so high in combination with direct stresses in truss C that side plates were added in several members.

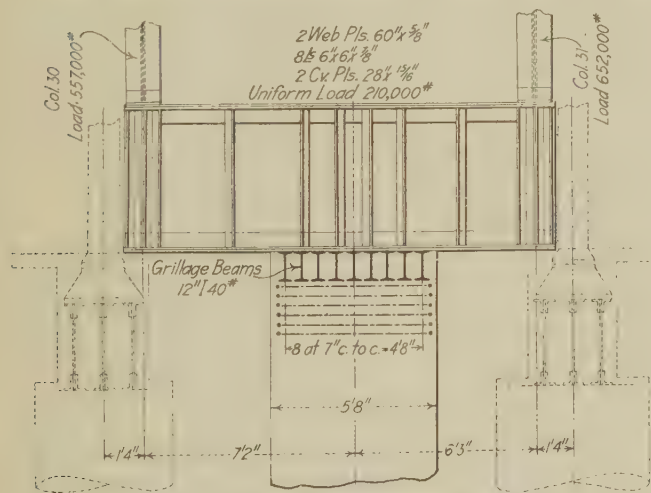
Lateral bracing, as indicated in the plan, is used at the tenth and eleventh floors between the wall trusses and the tank girders. This resists the lateral pressure of the water on these top flanges of the girders, which are made of unsymmetrical section, with the longer flange on the outside of the tank.

LINING OF TANK

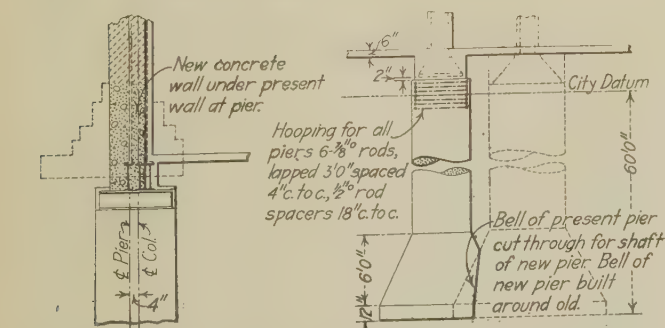
After much discussion, and after the objection of the contractor to the original specifications calling for membrane waterproofing, concrete and tile in conjunction with calking and welding to make the steel watertight, a lead lining was substituted. The rivet heads on the inside of the girders were flattened to $\frac{1}{2}$ in. and $1\frac{1}{2}$ in. of cement put on with a cement gun. Next to this, sheet lead weighing 4 lb. per square foot, or about $\frac{1}{16}$ in. thick, was placed, and fastened by tacking to wood strips set in the cement. The joints were soldered to make them watertight. Membrane waterproofing was placed next to the lead, 4 in. of cement put on with the cement gun and the lining faced with ceramic tile $\frac{1}{4}$ in. thick set in cement mortar.

The bottom of the tank was lined in the same way, except that less cement was used. The total thickness of the lining is 7 in. for the sides and 4 in. for the bottom. The outside of the girders were fireproofed with tile and plastered where they form the walls of rooms in the tenth story.

Seven new concrete piers were constructed to carry



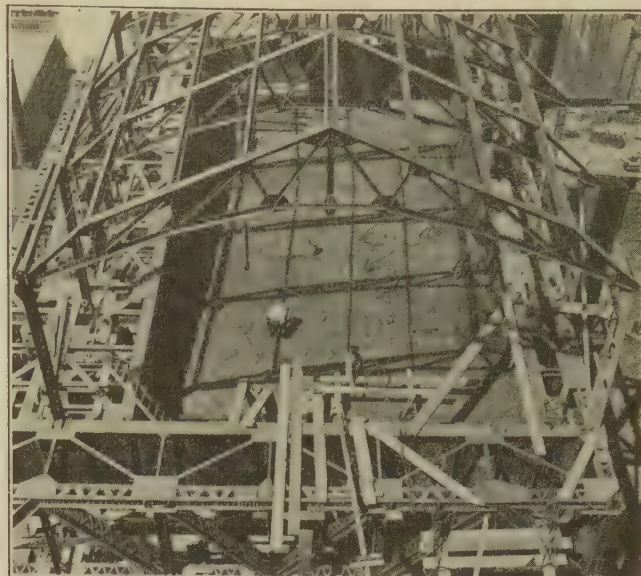
ONE PIER SUPPORTS COLUMNS 30 AND 31



FOUNDATION FOR COLUMN 25

TYPICAL ELEVATION OF PIERS

TYPICAL AND SPECIAL FOUNDATION PIERS OF CONCRETE



ROOF AND FRAMING OF SWIMMING TANK ON THE TOP FLOOR

the eight new columns. Columns 30 and 31 could not be placed on separate piers on account of interference with old piers, and were supported by balancing them over one pier, as shown in a drawing. The new piers vary in diameter from 4 ft. 4 in. to 6 ft., and extend to hardpan, being belled out to a diameter two and one-eighth times the diameter of the shaft.

SINKING CAISSONS

In sinking the caissons, the danger of settlement of the adjacent soil and of the old columns was avoided by applying an initial pressure to the firm clay soil as the caissons were sunk. This compression was exerted horizontally by using two sets of diaphragms and four jacks to each set of lagging.

All of the steelwork was erected by one derrick set up on the old eighth floor, the new columns in one and two-story lengths being lowered through the openings cut in the floors. The heavy trusses and girders were erected in 20-ft. lengths, requiring special shoring and bracing to hold them in place until the splices were made. After placing the new steel framework, the construction was carried through to completion in the usual manner.

Excavating at $3\frac{1}{2}$ Cents Per Cubic Yard

The "Yuba Sixteen," a gold dredge recently launched in the Sacramento Valley, California, is the latest addition to a fleet of dredges in that district, which is said to hold the record for quantity and economy. The new dredge is designed to bring up gravel from a depth of 80 ft. below water level, separate the recoverable gold, and deliver the waste over a bank 20 ft. high, thus lifting the material a total distance of 100 ft. The average cost of handling this material, allowing for a normal amount of trouble with boulders and buried trees, is $3\frac{1}{2}$ cents per cubic yard. The dredge is expected to move 4-ton boulders and under normal working conditions to excavate 350 cu. yd. per month. All equipment is electrically operated, and most of it is automatic, so that a crew of three or four men is all that is required.

Earth Lining Prevents Seepage in Porous Shale

Reclamation Engineers Give Results of Season's Operation on the 37-Mile Grand Valley Canal in Colorado

THROUGH porous shale sections seepage from the Main Canal in the Grand Valley Project of the U. S. Reclamation Service was materially reduced by earth lining or artificial silting. J. H. Miner, project manager, describes the method and results in the December *Reclamation Record*. The wetted perimeter of the length of the canal is largely in a gray shale in more or less advanced stages of disintegration. Generally it is finely broken up by nearly horizontal seams and vertical fissures. In this condition it is very porous. Excessive losses from the older canals in this region have resulted in waterlogging large areas below the canal. Frequently the accumulation of alkali was sufficient to prevent plant growth.

CONCRETE LINING NOT FEASIBLE

Lining with concrete was not considered feasible, since these shales swell when wetted so that concrete lining might be expected to become cracked and inefficient. The protective measures adopted consisted in excavating the canal through shale to a depth of 1 ft. below the required grade, with a view to allowing silt to accumulate in this extra depth. When cleaning may be necessary the silt in this section will not be disturbed. At some points where especially porous shale was encountered, the canal section was excavated with $\frac{1}{2}$:1 side slopes below the normal water level, but the top width of the wetted section was not changed. In this way a triangular section was formed on either side of and outside of the required water section. These triangular areas were later filled with good surface soil crowded off the top of the slope. Part of the earth lining was placed before water was turned into the canal, and part afterward. The work done with the water in the canal was the more effective in that the material compacted better and more quickly and also spread farther out on the canal bottom. Earth lining or artificial silting was necessary in one case, due to the fact that the Grand River carries very little silt.

"GOAT" ROLLER DOES COMPACTING

The local shales disintegrate very readily on exposure to air and moisture. Advantage was taken of this fact by plowing and harrowing the shale portions of the canal bottom in the fall of 1915 after water had been run in the canal. The upturned shale was left exposed to the elements through the winter, and in the spring was again stirred with a heavy harrow to assist nature further in the breaking-up process. The shale has a tendency to break up in flakes that do not compact readily. A so-called "goat" was devised to hasten the compacting. It resembles a land roller, or pulverizer, except that the faces of the rolls are provided with projections about 3 in. long, 2 in. in diameter at the tip, and spaced about 6 in. apart in each direction. The "goat" is hauled repeatedly over a given area and has the effect of trampling animals. It apparently made the canal bottom more compact, but

no data have been secured to show directly what its effect might be in reducing losses by percolation. This "goat" was delivered but a short time before water was turned into the canal in the spring of 1916, and consequently it was used on only a small part of the canal length.

EARTH LINING

Section 1 contains only a small part of shale, and the plowing and harrowing of this shale and the placing of the earth lining were completed in 1915. The "goat" was worked in a part of this section in the spring of 1916. Section 2 is perhaps 50 per cent in shale. This shale was plowed in the fall of 1915, and earth lining was placed in the late fall and early spring.

The section from Sta. 1375 to Sta. 1965, No. 3, contains a still greater per cent of shale. The shale was also plowed in the fall of 1915, but not harrowed, and the earth lining in this section was placed during the run of water in the season of 1916, that beyond Sta. 1850 being still uncompleted. Between Stas. 1100 and 1660 the canal was greatly benefited by silt brought in by a cloudburst on Aug. 13, which broke through the upper bank in a number of places. During the period from July 26 to Aug. 14, the Grand River water carried an unusually high percentage of silt, and as much of this water was taken into the canal as the conditions at the wasteways would permit.

LOSSES REDUCED RAPIDLY

The tabulation of conveyance losses shows the following results, all losses being given in cubic feet per square foot of wetted area for twenty-four hours:

On section 1, from Sta. 22 to Sta. 906, the loss during the period June 1 to 5 averaged 0.557; for the period from July 17 to 21 this had been reduced to 0.248, and for the period Aug. 27 to 31 to 0.201. In section 2, between Stas. 906 and 1375, the loss increased from 1.007 in June to 1.076 in July, and then decreased to 0.948 in the August period. In section 3 the loss increased from 1.94 in June to 2.118 in July and then decreased to 0.588 in August.

The increase in the July period for the second and third sections was probably due to the fact that a greater quantity of water was carried through those sections in July and the upper edges of the wetted area had not become compacted.

VARIATION OF LOSSES EXPLAINED

The variation in the amount of loss in the three sections is further explained as follows: In section 1 all work was completed before observations were begun, and the improvement was due solely to the deposition of river silt and other natural causes. In section 2 a very small amount of work was performed during the period covered by the observations, and very little effect was realized from the river silt. On account of being unable to waste water from the canal without damage to property, it was necessary to so limit the volume of flow through the canal that low velocities obtained, and hence practically all the silt was deposited in section 1. The large reduction in losses in section 3 was due to the large amount of work performed on this section during the period covered by the observations and to the silt deposited by the heavy inflow of surface water

during storms in the fore part of August. For the canal as a whole the losses during the June, July and August periods were, respectively, 1.013, 0.923 and 0.481 cu. ft. per square foot of wetted area for twenty-four hours.

SPECIAL TREATMENT GETS RESULTS

As an extreme illustration of the results obtained from earth lining and silting, observations were made in the vicinity of Sta. 1274 on the Main Canal, where the water prism is entirely in shale. The canal is carried by a flume over a wash at this point, and the bottom of the wash is about 12 ft. below the grade of the canal. Seepage appeared in this wash within twelve hours after water first reached this point in the canal, and continued to flow freely until the earth lining was placed and fine silt chuted into a temporary contraction of the channel above this section. During the silting operations a sack dam was maintained about $\frac{1}{2}$ mile down the canal to raise the water level 18 in. When the operations started the seepage flow down the wash measured by a Cippoletti weir was 2.45 sec.-ft. The placing of earth lining immediately reduced this to 1.96 sec.-ft. The artificial silting operations reduced the flow to 0.28 sec.-ft., or about 12 per cent of the original flow. No further work was done at this point, but the effect of further silting by storm water, two months' flow of river water, and settlement of the earth lining still further reduced the flow to 0.053 sec.-ft. In this instance the flow of free water was reduced 98 per cent.

LOCAL TREATMENT TO REDUCE LOSS

Observations on a 2-mile length of canal in shale on which no protective work had been done have shown an average loss of 4 cu. ft. per square foot of wetted area for twenty-four hours. The present observed loss of only 0.48 cu. ft. per square foot compares favorably with the losses observed by Don H. Bark in rather impervious clay soils in southern Idaho and with the conveyance losses accepted by Etcheverry for all material except impervious clay loam and medium clay loam underlaid with hardpan. By local treatment at points of greatest loss it is expected further to reduce this average rate for the first 37 miles. The remainder of the canal is located too far from the headgates to receive any of the silt taken in with the river water, and in order to eliminate conveyance losses in this lower portion of the canal, it is intended to install a silting plant, using pumps and a hydraulic giant to break up beds of suitable material and get it in suspension in the canal water.

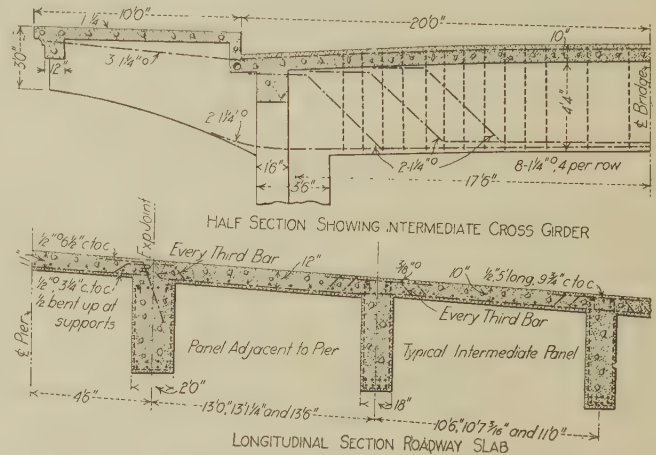
State Compensation Insurance Plan Works Well in California

A report on the State Compensation Insurance Fund in California announces that in the last fiscal year the income was \$1,837,761 and the net surplus over and above all liabilities was \$242,000. Dividends declared have amounted to 15 per cent of the premiums earned during 1914 and 1915. The actual refunds do not constitute the entire saving to patrons, it was pointed out, but represent a saving in operating cost only. The total average expense ratio is given as 14.47 per cent, or less than half that of insurance corporations.

Lead-Lined Expansion Joints in Floor of Concrete Arch Bridge

Five-Span Structure Designed for Seventy-First Street Crossing of Blue River in Swope Park, Kansas City, Mo.

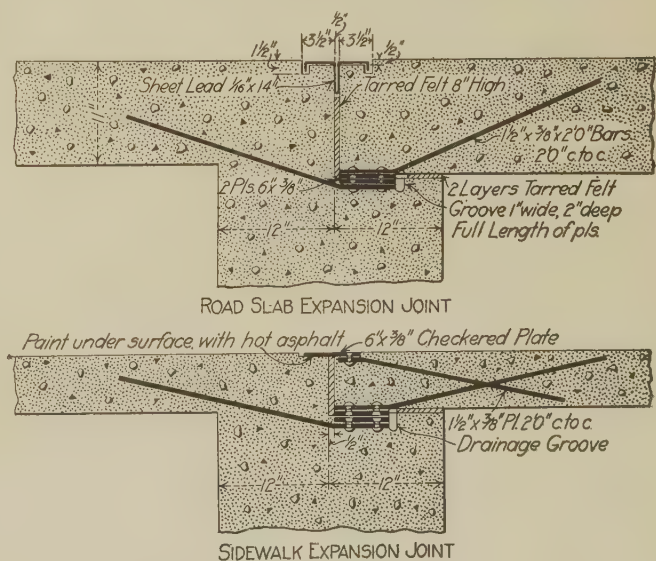
AMONG the design features of the five-span reinforced-concrete arch bridge for the Seventy-first Street crossing over the Blue River in Swope Park, Kansas City, Mo., are the details of the lead-lined expansion joints for the roadway slabs and the hooked ends for the reinforcing rods at these joints. The



TYPICAL REINFORCEMENT OF FLOOR SLABS AND CROSS-GIRDERS.

drawing here reproduced indicates the nature of these details and of the typical slab-and-beam reinforcement for the arch floor.

The bridge is designed as a practically symmetrical structure, except for the 5 per cent grade descending toward the east, with a 120-ft. clear span in the center over the river. The total length of 700 ft. consists of this 120-ft. central arch span, two 100-ft. spans, one on each side, two 60-ft. spans, one at each end, the 20-ft. intermediate piers and the hollow-box abutment or retaining walls, each 80 ft. long. All arches are of the open-spandrel type, with curved spandrel beams, and two main ribs supporting the cantilever cross-beams



ROAD SLAB AND SIDEWALK EXPANSION-JOINT DETAILS

either directly or by the spandrel columns. The roadway is 40 ft. clear and the sidewalk 8 ft. clear on each side. No trolley tracks are provided for in the design.

DETAILS OF EXPANSION JOINTS

The expansion joints in roadway and sidewalk slabs are placed on each side of each pier, thus varying from about 130 to 70 ft. apart. The joint in the roadway slab, as shown in the drawing, consists essentially of two 6 x $\frac{3}{8}$ -in. plates designed to slide on each other, the contact surfaces being coated with axle grease, and held in place by the $1\frac{1}{2}$ x $\frac{3}{8}$ -in. bars 2 ft. long, riveted to the plates by countersunk rivets. The $\frac{1}{2}$ -in. joint is filled with tarred felt and protected by sheet lead bent in to the joint and covered by hot asphalt up to the level of the top of the roadway slab, which is to be paved with 4-in. creosoted-wood block.

For the sidewalk slab a similar joint is designed, except that a checkered plate is used instead of the bent lead plate and asphalt filler. Outside of the steel bearing plates the horizontal joints are to be filled with two layers of tarred roofing felt separated by a layer of plain roofing paper saturated with paraffine oil.

REINFORCEMENT DETAILS

Among the details of the reinforcement, which are indicated in the drawing, attention is called to the hooked ends of rods at the expansion joints and the $\frac{3}{8}$ -in. spacer rods in the top flange of the cross-girders.

The design of this bridge was made by Waddell & Son, of Kansas City, Mo. The contract was awarded to the Horton Concrete Construction Company, of the same place, on Nov. 22 for a little less than \$145,000. Construction has begun under the supervision of the designers as consulting engineers for the Board of Park Commissioners of Kansas City.

Hawaiian Tunnel Driven by Japanese Labor Working Waist Deep in Water

C. H. Kluegel Describes Difficulties Caused by Heavy Inflows Which Were Used Ultimately as Source of Power for Construction

WORKING waist deep in a torrent of cold water caused by an inflow of as much as 35,000,000 gal. daily, Japanese drillers and muckers, in 6-hour shifts, drove the 7 x 7-ft. main tunnel of the Waiahole Water Company's new supply system for irrigating sugar land in Hawaii against discouraging odds. To cope with the water which poured into the bore as the north heading advanced, the floor was first lowered in order to facilitate drainage by gravity. Then two siphon pipes were installed, but failed to give the desired relief. Finally it became necessary to drive a relief or drainage tunnel parallel to the main tunnel and at a slightly higher level in order to intercept and carry off a portion of the troublesome inflowing water. This cut down the flow to a point where it was possible to advance the north heading about 12 ft. a day and the tunnel was holed through Dec. 13, 1915. A unique feature of the project was the use of the inflowing water from the tunnel heading as a source of power for operating the construction plant. A 350-hp. Pelton waterwheel was installed in a gulch near the north portal and operated

under a head of 250 ft. A description of the general plan of the new water supply system and of the difficulties encountered in its construction was given recently in a paper before the Hawaiian Engineering Society by Charles H. Kluegel, under whose direction the work was completed. From this paper the following extracts have been taken.

GENERAL PLAN

The general plan provided for collecting the water from the many streams and gulches on the windward side of the Island of Oahu by means of tunnels through the ridges or spurs, and conveying it through the mountain in the main tunnel to the leeward side of the island, thence by tunnels, ditches and pipes to the upper levels of the Oahu sugar plantation. The tunnels connect the various streams on the north side and take in the water at the adits in the gulches. There are twenty-seven of these tunnels on the north side, varying in length from 280 to 2332 ft. The aggregate length of the north side tunnels is 24,621 ft., or 4.66 miles, being in reality one continuous tunnel. The number of adits at which water is taken in is thirty, the intakes being located at the most advantageous points at the streams in the gulches.

The length of the tunnels on the south side is 19,211 ft., or 3 $\frac{5}{8}$ miles, this distance comprising 14 tunnels, varying in length from 346 to 3329 ft.

The length of open ditch between the last tunnel and the Waikakalaua gulch is 20,000 ft., or 3.79 miles. This portion of the waterway crosses three gulches, where riveted steel pipes are used, ditches being impracticable. The aggregate length of steel pipes is 4460 ft., and the diameters vary from 72 to 78 in.

SUBDIVISION OF WORK

For convenience of administration, the project was subdivided as follows:

	Ft.	Miles
North division tunnels	24,621	4.66
Main tunnel	14,567	2.76
South division tunnels.....	19,211	3.64
South division ditch.....	20,000	3.79
Pipes	7,290	1.38
Hoaeae ditch	12,650	2.40
Honouliuli ditch		approx. 2
Distributaries		approx. 6
Total		26.53

At the beginning of the tunnel work, three shifts of 8 hours each were kept going. This was continued until the large amount of water coming into the tunnel, at the north heading, became troublesome. On account of the hardship to the men, working for 8 hours in the cold water, it became necessary to cut the shifts down to 6 hours each, so that four shifts per day were employed for this heading. The temperature of the water in the tunnel was approximately 66 deg. Fahr., or about 8 deg. colder than the artesian water in Honolulu.

The main bore had proceeded only about 200 ft. from the north portal when water to the extent of 2,000,000 gal. daily was developed on breaking through the first dike. These dikes are hard, impervious strata of rock lying approximately at an angle of 45 deg. to the tunnel axis, and nearly vertical, and they occur at intervals of varying length. Between the dikes was the porous water-bearing rock, thoroughly saturated, and with the water often under considerable pressure. When a dike

was penetrated, the water would spout out from the drill holes and would gush from the openings blasted in the headings. As the work progressed, the water increased in quantity, and the difficulty of the work was enormously greater on account of the water.

The slope of the tunnel being downward from the north portal, the matter of getting rid of the water by drainage was also one of great difficulty. This at first was managed by lowering the floor at the north portal about 2 ft., this being thought sufficient at that time, and allowing the water to drain out by gravity.

WORKING WAIST DEEP

At about 900 ft. from the north portal, the flow of water having increased to 26,000,000 gal. daily, the floor was again lowered to 5 ft. below grade at the portal, and at this stage the men in the heading were working waist deep in cold water, in a perfect torrent, the inflowing water coming principally from the face and from the roof and sides for a distance back from the heading, the flow of water apparently following the heading fairly closely. The pressure of water in the drill holes interfered very much with the blasting, so that the ordinary methods of charging and firing could not be used. The final expedient resorted to to hold the dynamite in place until it could be fired was to pack the sticks of explosive in thin metal tubes of the diameter of a stick of powder, and of sufficient length to inclose the quantity of powder desired. This scheme gave good results, but was expensive and materially delayed progress.

The texture and hardness of the rock varied considerably—some of it being particularly soft and porous and much of it hard and flinty, particularly at the dikes. The dikes varied in thickness from 14 ft. down to about 4 ft., but all the dikes were composed of very hard, close-grained rock which was apparently waterproof. The rock, however, was gritty and abrasive lava, and necessitated an unusual amount of drill sharpening, two of the latest type drill-sharpening machines being kept busy all the time.

DRAINAGE TUNNEL DRIVEN

When the water had increased to the point where it could not be drained out by gravity by lowering the floor at the north portal, a siphon pipe made of redwood, 16 in. in diameter, was installed, and this made it possible to drive the work ahead a short distance farther. A second siphon pipe 20 in. in diameter was next installed at the side of the tunnel immediately over the top of the 16-in. siphon, and this gave further relief and made it possible to extend the north heading to approximately 1400 ft. At this point the maximum inflow of water was approximately 35,000,000 gal. daily, which was taken out by the two siphons and gravity drainage.

It was seen that the siphon method alone would not suffice for further drilling, so a relief or drainage tunnel was driven on the west side of and parallel to the main tunnel at a slightly higher level and on an ascending slope from the portal, its object being to intercept and drain off a portion of the troublesome inflowing water. This expedient proved helpful after the tunnel was extended in about 1400 ft. The two tunnels were then worked alternately, the floor of the main tunnel being kept above grade to avoid having the tunnel men

work so deep in the water. They were working at this time in water about 3 ft. deep.

RELIEF TUNNEL ACTS AS DRAIN

This alternate working was continued to 1700 ft. from the north portal, where a chamber was blasted out of the solid rock on the side next to the relief tunnel. A cross-cut was made to connect the two, and a centrifugal pump of 13,000,000 gal. capacity was installed, which raised the water of the main tunnel through a pipe to the relief tunnel, which at this point is about 18 ft. higher. The relief tunnel acted as a drain.

With this arrangement, the work proceeded until the two headings met on Dec. 13, 1915, and although the trouble and difficulty with the water never entirely ceased, it was possible to proceed slowly at an average rate of about 12 ft. per day of 24 hours with three shifts.

SOUTH HEADING PROGRESS RAPID

From the south portal the progress was rapid, often as high at 630 ft. per month, or about 21 ft. per day on an average, notwithstanding the long haul, which at the last was over 2 miles.

The first dike on the south side was struck at 10,518 ft. from the portal, the first evidence of water being from the drill holes, from which the water spouted under pressure. The measurements of pressure by gage on some of the plugged drill holes showed a pressure of 65 lb. per square inch, corresponding to a static head of 150 ft. When water was struck, the excavation was discontinued temporarily. The spouting drill holes were plugged, the track was removed, and the floor of the tunnel, which up to this point was mainly through porous rock, was lined with concrete with a plastered cement surface. The walls in the meantime were lined and cemented to make them watertight. Such portions of the tunnel as required overhead arching had been arched and made ready for use.

The track was then replaced and the work continued at reduced speed, due to the water, which came in in large quantities, the maximum flow from this heading reaching 17,000,000 gal. daily, until the two headings met at 11,679 ft. from the south portal.

WATER AFFECTS PROGRESS OF DRIVING

From the foregoing it will be seen that 80 per cent. of the length of the main tunnel was driven from the south portal, and 20 per cent of the length was driven from the north portal, the difference in these proportions from the two headings being due to the presence of water at a much earlier stage in the north heading. Had there been no water to contend with, the length driven from each heading would have been approximately the same.

In order to give room for the water to flow from the heading, the track was raised on 4 x 12-in. timbers placed edgewise as stringers, on top of which the track ties were laid. The track was 24-in. gage, laid with 16-lb. and 20-lb. T-rail. The cars used were the standard Koppel 1-yard, all-steel dump cars. Electric locomotives driven by storage batteries were used in both headings. These gave good service on short hauls, except for the necessity of frequent recharging of the batteries, and minor difficulties due to water.

A gasoline-motor tractor was used for the long haul, until the track was raised in the south heading, the raising of the track leaving insufficient clearance for the gasoline locomotive.

CABLE HAUL INSTALLED

A cable haul was then installed, this operating without interruption from the water and clearance. The steel cable used was $\frac{1}{2}$ in. in diameter, and was approximately 4 miles in length, spliced to make a continuous cable, and running over a sheave secured to a timber in the floor of the tunnel at 10,800 ft. from the south portal. The cable tractor was a double-drum puller with a cable tightener, and was driven by belt and gearing from a 50-hp. electric motor. There was considerable wear on the cable, due to abrasion on the ties. This wear was much reduced by damming up the water in the tunnel at frequent intervals in order to permit the cable to run in the water, which apparently acted as a lubricant and reduced the wear. The cable parted on two occasions, and delayed the work until a splice could be made. One cable was completely worn out and the second cable used was probably about half worn out, over a period of eight months.

POWER PLANT USES TUNNEL WATER

The plant which actually supplied the power for use at the tunnel was a 350-hp. Pelton waterwheel belted to a 300 kw. three-phase generator, these units being installed in the gulch below and near the north portal. There was an abundance of water from the north heading, and the head at the Pelton wheel was 250 ft. This made an inexpensive and easily operated plant which was entirely satisfactory except at rare intervals when the water was low. The power was transmitted by pole line to the south portal in the opposite direction to that originally planned. For emergency use a steam power plant was equipped.

The local plant at each portal contained a duplex two-stage Ingersoll-Rand air compressor, supplying 800 cu. ft. of free air per minute at a pressure of 100 lb. per square inch, belted to electric motors; receivers, Leyner drills, sharpening machine, pumps, blacksmithing equipment, blowers for ventilation, a number of small machine tools for repair work, and facilities for making up the metal powder tubes. The air drills used were the water Leyner drills up to 10 ft. long. These drills use a jet of water under pressure which forces out the cuttings from the point of the drill. They are capable of rapid drilling, there being very little interruption from the clogging up of cuttings.

FOUR-INCH LINE SUPPLIES AIR

Air was supplied to the drills by a 4-in. pipe line running to a manifold which was always near the heading. Each round required from 12 to 20 holes, 8 to 10 ft. in depth, the holes being drilled at slightly converging angles in order to break the rock effectively. Each round required from 50 to 100 lb. of 40 or 60 per cent dynamite, Giant brand being used.

The ventilation of the tunnel headings was secured by forcing air by means of blowers through 16-in. metal pipes which were carried along the side of the tunnel, the air being forced in continuously. When a shot was fired, the direction of the blower was reversed for a

while, and the smoke and foul air were drawn out of the tunnel through the pipe until it was clear and fit for the men to work. This arrangement of ventilation proved effective and saved a great deal of time.

JAPANESE LABOR EFFICIENT

Special tribute should be paid to the Japanese tunnel men, without whom the excellent progress made on the tunnel would have been impossible. These "professional" tunnel men, as they call themselves, prefer this work to any other, and they apparently take delight in the hardships incident to the work, the exposure to the cold water, and the risk in handling explosives. They were on the job all the time and never failed to "deliver the goods" in situations in which white men or native Hawaiians would have been physically impossible. Most of the drilling and mucking was done by these tunnel men as subcontractors—a bonus being given for rapid work, which never failed to give results.

The general plan of development was recommended by J. B. Lippincott, consulting engineer, assisted by W. A. Wall. J. Jorgensen also had made a study of the project. H. K. Bishop was chief engineer when construction began in February, 1913, and was succeeded, after his resignation, by C. H. Kluegel. J. M. Young served as consulting engineer, and H. Olstad was superintendent in charge of operating the completed system.

Autos Outstrip Railways in Bulk of Passenger-Mileage

Value of Motor Passenger Service Exceeds That of Railways by \$200,000,000 Annually—Figures Given for Motor Trucks

By H. W. PERRY

Secretary, Commercial Vehicle and Good Roads Committee,
National Automobile Chamber of Commerce

PASSENGER automobiles are to-day rendering a greater transportation service than the entire steam railroad system of the country and greater than that of all electric railways. This statement seems almost unbelievable, yet the facts appear to prove it.

There are now registered and in use in the United States more than 3,000,000 passenger automobiles, after deducting duplicate registrations. The average mileage traveled by an automobile, based on conservative estimates, is 5000 a year. This gives a total annual mileage for all cars of 15,000,000,000. Assuming that the average number of passengers per car is three, the total passenger-miles per year is 45,000,000,000. On the basis of 2 cents per mile, the approximate average railroad fare, this service is worth \$900,000,000.

VALUE OF PASSENGER SERVICE

For comparison with these figures we have the latest report of the Bureau of Railway Economics showing that in 1914 the railroads carried 1,053,000,000 passengers an average distance of 33.6 miles, or 35,258,500,000 passenger-miles. The average fare was slightly less than 2 cents per mile, producing a revenue of \$700,400,000. Therefore automobiles render a passenger service worth nearly \$200,000,000 a year more than that of the railroads.

The latest street-railway figures at hand are for the year 1912, but as there has not been any marked extension of electric-railway systems and service in the last four years, and many such roads have reported heavy decreases in passengers and receipts during the last two years, the report for 1912 provides a fairly accurate basis for comparison. In that year these roads carried in excess of 9,500,000,000 passengers an average distance of 4 miles, or 38,000,000,000 passenger-miles. The total revenue from this service was slightly more than \$500,000,000, averaging 1 1/3 cents per mile per passenger. At this rate of fare the automobile gave service worth \$598,500,000, or \$98,500,000 more than the street and electric roads.

FIGURES FOR COMMERCIAL VEHICLES

Use of commercial motor vehicles has not yet reached a stage of development comparable with the passenger cars, yet the service they are giving mounts into large figures also. There are estimated to be 250,000 commercial motor vehicles in use. They average 50 miles a day, or 15,000 miles in a year of 300 working days, making the yearly total mileage 3,750,000,000. At least half this mileage is traveled with load. Assuming that the average load is 2 tons, the commercial motor vehicles of the country perform a service of 3,750,000,000 ton-miles.

By comparison, the steam railroads in 1914 gave 288,320,000,000 ton-miles, and earned a freight revenue of \$2,114,700,000, or a little more than 7 mills per ton-mile. At this rate the motor-truck service was worth only \$26,250,000.

MOTOR TRUCKS DO NOT COMPETE WITH RAILROADS

Motor trucks do not compete with the railroads in freight haulage, however, but take the place of, or supplement, horse-drawn vehicles. From an exhaustive investigation of haulage costs made by the U. S. Department of Agriculture the average cost of hauling to market is about 24 cents per ton-mile. Other investigations of city haulage show that the average cost of haulage by horse is about 17 3/4 cents. Taking 20 cents as a fair average value of haulage by highway, the motor-truck service is worth \$750,000,000 a year.

An official verification of the great service given by motor trucks and omnibuses is contained in the annual report of the New York State Highway Commission for 1915. A careful census of this traffic made in all the counties of the state, outside of cities and villages, showed that during a period of forty weeks (excluding the twelve winter weeks) these vehicles ran up a total of 14,734,680 miles and a ton-mileage of more than 60,000,000.

MOTOR TRAFFIC AND ROADS

The enormous value of passenger and freight service that is afforded by motor vehicles, aggregating a gross of \$1,650,000,000 a year, warrants the most conscientious study of how the public highways shall be improved to aid the development of this tremendous economic factor in the industrial, commercial, social and educational progress of the country. Shall the use of motor vehicles, particularly of trucks and buses, be restricted to meet the condition of the roads and bridges, or shall the roads and bridges be improved

much more rapidly than heretofore to sustain this traffic?

More than 82 per cent of all traffic on the 1100 miles of the state highway system in Massachusetts in 1915 was self-propelled. Wherever a similar census of traffic has been taken it shows a large predominance of motor vehicles using the roads. Obviously, the best interests of the country will be served by developing the main highways to meet the rapid progress that is being made in transportation by highway.

Flume Raised and Lowered Instead of Using Inverted Siphon

Concrete Counterweights Eliminate Heavy Lifting
—Flume Has Been Used Four Years—
Adapted to Long and Short Spans

By C. D. CONWAY

Superintendent and Engineer, Los Molinos (Cal.)
Land Company

THE "LIFT FLUME" shown in the photograph was designed and installed by the writer four years ago on the Los Molinos Land Company's irrigation system in Tehama County, California. The canal crosses the creek much lower than high-water level. As the grade is only 0.0007 per foot, it would have been necessary to



LIFT FLUME USED FOUR YEARS GIVES ENTIRE SATISFACTION

lose considerable head if an inverted siphon had been used. The company desired to maintain the grade in order to cover all the land possible.

A smooth No. 7 standard flume, having a capacity of 28 sec.-ft., was used in making the flume here illustrated. The lift portion consists of two 32-ft spans with six concrete counterweights as shown. After the water is turned off in the fall, the entire 64 ft. is raised simultaneously by two men, one at each end. No heavy lifting is required, as the flume and counterweights balance almost perfectly. A number of 50-lb. concrete blocks were made for additional weights, but it has never been necessary to use them. In the canal, a short distance from the lower end of the flume, a check-gate prevents the flood water from entering. During the last four years this flume has caused no trouble despite the fact that every winter the unraised portion has been submerged.

There are two other lift flumes on the project, one a 48-ft., the other a 32-ft. span. Both are constructed and operated as the one shown in the picture, except that they are single spans and therefore only four counterweights are necessary. They also have given entire satisfaction.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

"Standard" Pavement Specifications

SIR: My attention has been called to your news item and editorial reference to the convention of the American Society of Municipal Improvements recently held in Newark, and I beg space in your paper to briefly answer two points of rather personal reference.

Reference is made to opportunity given to a "manufacturer of a patented pavement—standardized by the society—to deliver not one but two addresses exploiting his product." There can be no doubt in the minds of anyone familiar with the subject that this is a direct, as it is an unjust, reference to the writer. The two addresses referred to were:

1. Motion pictures of the Columbia River Highway presented by the writer in his brief remarks of introduction, in which he very carefully refrained from making any reference whatever to the fact that Warrenite road surface, laid over the old macadam, is used on the 70 miles of Columbia River Highway and its approaches from the city of Portland, and confined his brief remarks strictly to the engineering problems solved and the scenic beauties and what prominent visitors have said about the highway. Among others, he read the following quotations of:

Gen. George W. Goethals, of Panama Canal fame: "The Columbia River Highway is a tremendous engineering accomplishment and it is the most wonderful scenic boulevard in America."

Ex-President William H. Taft, on visiting the Columbia River Highway in the summer of 1915, made a statement in an interview in the public press, strongly expressing the magnificence of the highway. (His exact statement is not before me at this writing.)

Ex-Governor Charles E. Hughes, following an automobile trip over the Columbia River Highway, Aug. 20, 1916, said: "It is the most wonderful highway I have ever ridden over."

Many thousands of visitors from all parts of the United States and Canada travel thousands of miles to see the Columbia River Highway. The average Sunday traffic is more than 4000 automobiles. Nearly every prominent magazine of the country has given illustrated articles about it. A comparatively few have had the opportunity of seeing about 150 natural-color pictures of the road.

During the past summer a motion-picture film was taken at the expense of the Portland chapter of the Shriners as its contribution to the program of the Shriners' National Conclave held at Buffalo in July. Learning that a loan of the motion-picture reel might be secured for the A. S. M. I. convention, I called the attention of the management to the opportunity, and was requested to secure its use and to present it to the convention. Being the second best way to see this wonderful engineering-scenic accomplishment, I thought I was proposing a real service to the convention, and

the large number of remarks made to me after the showing of the pictures indicated that it was regarded as a real treat.

2. The other of the "two addresses exploiting his product" is the writer's paper, regularly on the program, and written at the special request of both the chairman of the paving committee and the secretary of the society, on the subject, "The Passing and Conservation of Macadam City Streets and Country Roads."

Only twice in the paper was the word "Bitulithic" used, and then almost necessarily in connection with the reference to the typical instances referred to.

Now to the point which has been the subject of your several editorial references of the past year, to wit—the adoption at the Dayton (1915) convention of specifications for Bitulithic pavement.

Permit me to call your attention to the fact that the adoption was not made at the request, or even suggestion, of the writer, nor any other member of the company or organization he represents. On the contrary, the *Proceedings* of the Boston (1914) convention will show that the recommendation was first made by the chairman and the other members of the subcommittee, which at Dayton in 1915 most strenuously and in an improper "snap" proceeding endeavored to defeat its accomplishment, and by a more unparliamentary, improper and "snap" proceeding at Newark in 1916 endeavored to retract its adoption.

On the merits of the matter, permit me to ask a few important questions, to wit: What is a "standard pavement"? Is the proper adoption of specifications for all types of "standard pavements" limited to either patented or unpatented constructions? How long and under what varied general or extreme conditions must a pavement be used to become "standard"?

My view is that when, as is the case of Bitulithic, it has been in practical successful use for 15 years, adopted in over 400 cities, to the extent of over 43,000,000 sq. yd., under climatic conditions ranging from 45 deg. below zero in Edmonton, Alberta, to 140 deg. in Phoenix and Tucson, Ariz., and El Paso, Tex., that it is not only a "standard pavement," but that any committee or organization in adopting specifications for all types of "standard pavement" would be very derelict in its duty if it did not include this "standard" merely because it happens to be patented.

I further contend that it would be still worse to lead the public into unwitting infringement by adopting specifications for a standard construction—pavement or otherwise—which is in fact patented without so labeling it or by endeavoring to adopt something not standard because not sufficiently used to give it the dignity, but supposed to evade a meritorious patent, and which may not even accomplish that, but in the effort to evade, certainly would provide an inferior result.

Understand, I am not arguing for or against the adoption of specifications for any *one* pavement, pat-

ented or otherwise. In fact, I think "standard" specifications should include every form of construction which has had a long or broad enough practical use to prove its efficiency and economy, whether the desideratum be from either the point of view of high grade and correspondingly higher cost, or from the point of view of lower cost and, although inferior, economically useful at the price.

My insistence, however, is that an article is no less "standard" and should be no more shunned in the adoption of "standard" specifications because the proper government departments have granted and adjudicated patents proving its novelty. If anyone will brush away prejudice and, on that basis, give any sane reason why Bitulithic is not a "standard pavement" and why, as such, it should not be included in any set of "standard pavement specifications" adopted by any society broadly covering the field, they will be offering something which I have not yet seen or heard expressed.

GEORGE C. WARREN.

[Mr. Warren says he did not mention Warrenite in his talk on the Columbia River Highway. A "cut-in" on the film, however, did say that Warrenite (or Bitulithic, we forget which) was used. With reference to the address on "Passing and Conservation of Macadam City Streets and Country Roads," in addition to the two mentions of Bitulithic referred to by Mr. Warren, the preprints of the paper contained five pictures, and beneath each was a description saying that Bitulithic was used. In other words, as printed, there were seven, not two, references to Bitulithic.

On the matter of standardizing a patented article, we consider it incompatible with the dignity and principles of a technical society to show commercial partisanship. If Bitulithic can have a specification, why not every other patented paving that has proved its worth? It is the very injection of commercial matters which has discredited the American Society of Municipal Improvements and made it the laughing stock of those who know of the disgraceful character of some of its convention sessions.—EDITOR.]

City Should Pay Royalty Fee on Patented Devices

SIR: For many years municipalities have protected themselves against patent claims by inserting in their contracts a clause specifying that the general contractor shall assume all liability for patents and shall relieve the city from liability and render harmless the officials, etc. It is doubtful whether such a paragraph would apply to a patent obligation where the city specified a patented article, as shown on the drawings, and the contractor simply constructed, in accordance with his contract, the patented appliance or method of construction.

If the city pays the fee direct either to the patent holder or to his representative, it secures thereby a direct receipt. It is the city's right to have and to hold the license to use a patented article or process which has been called for by the engineer and which has been constructed by the contractor in accordance with his contract.

The city cannot obtain this license except by payment of the fee, and if the fee is to be paid by the contractor

it is important that the contractor know in advance of preparing his estimate what the fee amounts to and to whom it shall be paid; and if these formalities on the part of the city are carried out the contractor should make the payment specified to the proper party, obtain the license, and surrender it to the city.

It seems, therefore, important, and quite to the city's interest, that specifications for the use of the Imhoff patented sewage tank should specify the amount of the royalty fee, the person to whom payment shall be made, and the surrendering of the license by the contractor to the city before final settlement is made with the contractor for the work.

S. FISCHER MILLER,

President, Pacific Flush Tank Company, American and Canadian Commercial Representatives of Dr. Karl Imhoff.

New York City.

What Are They Doing About It?

SIR: The report of Prof. Ira O. Baker on the Chicago pavement conditions (abstracted in the Engineering Record of Dec. 9, page 702) has for the time aroused discussion. The question is being asked, "What will the citizens of Chicago, the responsible officials and others, do about it?" The reply almost invariably has been in a pessimistic tone, "Nothing. After the daily press has given the usual sensational treatment to the report, it, like many other vexatious things, will promptly be forgotten."

Pressing the question a little farther, may we not properly ask whether the engineers, especially those who are taxpayers of Chicago, do not have a duty not merely to the community but more immediately to the profession and to themselves, to see to it that reports of this kind are not pigeonholed but form the basis for systematic and persistent activity toward better engineering results.

In and about Chicago are several more or less active associations of engineers. Each of these has been formed for the advancement of engineering knowledge and practice and the maintenance of high professional standards among its members. The youngest of these organizations, and for this reason the one which from its extreme youth should be the most active, is the Illinois Association of Members of the American Society of Civil Engineers. This association has been formed in order that members might be able to express their views collectively with regard to the management of the society and to engage in such other activities as may be deemed desirable. It includes the men who stand at the top of the profession and whose opinion on all affairs has great weight. They may properly feel, however, that their interests should extend only to the purely technical details and not to the application of these to problems of daily life.

There is also another new organization of over a thousand members, the American Association of Engineers, composed of the younger men, most of whom "still have their future yet before them." They, too, are endeavoring to raise the ethics of the profession and to assist their members in every practicable way.

Still older, and with a well-established place in the community, is the Western Society of Engineers, with

its large membership, also the Illinois Society of Engineers, many of whom live in Chicago. Other associations might be named, but it is sufficient to call attention to the fact that we have several well-organized representative bodies of engineers equipped for effective work. The question is therefore not whether there is any one to do the work, but "Is the undertaking of a kind which would justify or require action by one of any body of engineers?" Or perhaps to put it another way, are the engineers, as a whole, concerned in a case like this, where it has been shown by one of the oldest, best-known engineers of the state that certain indefensible conditions exist in engineering work?

No question can be raised as to Dr. Baker's ability and fairness. His well-known textbook, "Roads and Pavements," has been widely used throughout the country. His large experience and mature judgment entitle his opinions to respect. His recent report to the Committee on Finance of the City Council of Chicago, dated Nov. 20, 1916, shows that certain engineering work has been badly done. The result is only too evident. The public, not fully informed upon all details, naturally lays the blame upon the engineers.

The advancement of engineering knowledge and practice and the maintenance of a high professional standard are retarded every time the public's attention is called to poor work on the part of professional men. This is intensified if the professional men, individually and collectively, ignore the existence of poor work and simply pass it over; silence gives assent. To this extent they are undoing the very object for which their organizations are formed. We may well ask, under such conditions, "Would the doctors or lawyers acquiesce by their silence?" It is fairly safe to assume that if a lawyer or doctor of high standing found it necessary to condemn certain professional work the local associations would immediately take up the matter and see to it that, as far as lies within their power, these improper conditions should no longer continue. It is by such prompt and effective attention that other organizations of professional men now retain their high standing in the eyes of the community. They cannot afford to let it be understood that improper, or even dishonest, practices are quietly tolerated.

High standing in the community is attained only by eternal vigilance, which is the price of high ideals. If, as many assert, the engineering profession is not highly regarded by the public, is it not because the engineers, through their associations, have failed to safeguard their reputation and by their inactivity at crucial times have confirmed the belief in their timidity or unwillingness to take any risks of contamination in connection with everyday affairs?

In endeavoring to maintain a splendid isolation from commercialism or worldly affairs are the engineers not losing the very thing for which they should strive? In other words, in quietly ignoring the conditions which Dr. Baker's report has revealed, are not the engineers of Chicago permitting the profession to sink in the esteem of other citizens?

An illuminating example of what has been done elsewhere is afforded by the action of the Affiliated Engineering Societies of Minnesota, which, according to their bulletin of Dec. 10, 1916, appointed a committee to investigate certain alleged extravagances in connec-

tion with a highway bridge. The report shows that the work was let at an exorbitant figure, and that the extras make the total cost still more exorbitant. It was inferred that the work was poorly done, due to lack of business judgment in letting the contract and to the adoption of inefficient methods of work and absence of proper supervision. The report recommends that the State Highway Commission do not furnish plans for bridges unless provided with authority and sufficient funds to maintain adequate supervision over the letting of the contract, the construction, and the final acceptance of the work.

It is also interesting to note that the members of the committee making this report served as a committee of the Northwest Association of Members of the American Society of Civil Engineers. Can or will their Chicago brethren follow the precedent thus established?

F. H. NEWELL,

Professor of Civil Engineering, University of Illinois,
Urbana, Ill.

Financial Status of the Pacific Gas & Electric Company

SIR: My attention has just been called to an article which appeared in the Engineering Record under date of Nov. 11, 1916, page 588, being a reprint of a paper presented by Leonard Metcalf, Oct. 11, 1916, at a joint convention of the Illinois and Iowa sections of the American Waterworks Association. While I am not disposed to discuss in any way the general scope of the paper by Mr. Metcalf, I must take a positive exception to certain statements therein made which are not founded upon facts and which, coming from a man of his reputation, are certain to work injury to this company.

In the article you make a subheading "Corporations in Financial Straits." Mr. Metcalf follows with the following statement: "Similar experience has developed in the Far West in the State of California, where, from one cause or another, acts of the corporation on the one hand, and on the other hand of the commission, or other public representatives, a large number of public service corporations are at present in financial straits. Among these might be mentioned . . ." He then goes on to give the names of a number of corporations in this state, among which he includes the Pacific Gas & Electric Company.

I cannot conceive where Mr. Metcalf obtained his information regarding the financial status of this company. He certainly has not read our annual reports, nor has he taken cognizance of all financial reports of this company filed with the Railroad Commission of this state. This company certainly is not in financial straits. It is perfectly solvent, is paying its dividends, and, except for its funded debt, is entirely out of debt, and has a very substantial surplus on hand. Its financial standing for the twelve months ended July 31, 1916, is herewith inclosed, showing the income account and the balance sheet. [The full statement is not reproduced, but the condensed balance sheet, dated July 31, 1916, shows total assets of \$150,399,541, total liabilities of \$144,890,875, leaving an unappropriated surplus of \$5,508,666.]

I have always been impressed with the fairness of

your journal in dealing with corporation situations, and am manifestly surprised that you should have permitted an article making an absolutely incorrect statement space in your journal, and trust that you will give it correction in your next issue.

While discussing the paper of Mr. Metcalf only with reference to its mention of the Pacific Gas & Electric Company, I cannot forbear to repeat what I have often said—that the corporations of this state are satisfied with regulation, and that, so far as the other companies mentioned by Mr. Metcalf are concerned, regulation had nothing to do with their financial straits; rather has regulation by the commission been helpful in solving the difficulties which they found themselves under by their own acts prior to regulation being in force.

JOHN A. BRITTON,

Vice-President and General Manager, Pacific Gas & Electric Company.

San Francisco.

[A copy of Mr. Britton's letter was submitted to Mr. Metcalf, whose reply follows.]

SIR: Thank you for your courtesy in submitting to me for comment copy of letter received by you from John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company of San Francisco, containing strictures upon a reference made in an address upon "Some Observations Upon Public Regulation of Waterworks," delivered by me on Oct. 11, 1916, before a joint convention of the Illinois and Iowa sections of the American Waterworks Association.

I regret that in making allusion to specific cases I should not have spoken more explicitly and limited the scope of my observations, as it appears from Mr. Britton's letter that the intent of my comment has been misconstrued. I regret this because, of course, I should be loath to give any false impression, and I am very glad of the opportunity to state that the present condition of the Pacific Gas & Electric Company financially is, I believe, as Mr. Britton has represented it.

The use by me of the words "in financial straits" was unfortunate. It would have been wiser to have used some such expression as "a large number of the public service corporations have suffered financially in the past." What I particularly had in mind, and what I believe to be true, generally speaking, of corporation control in the past, is that the earnings permitted many corporations have been somewhat smaller than desirable from the point of view of the public interest; that is, they have been such as to tend to make the service rendered by the corporation follow the demand rather than to anticipate it, and as to make it difficult for the corporation to borrow money upon the lowest possible basis. According to my view, the public suffers, as well as the corporation, from an impaired or too seriously limited corporate credit.

Moreover, I think that Mr. Britton has failed to appreciate my reference to "other public representatives" as well as to the commissions. In making this reference I had in mind certain other boards which antedated the commissions but which had power of control. Such an example is to be found in the Board of Supervisors of the city of San Francisco, in the hands of which was lodged the determination of the water and other rates, and by which board rates have been established in the

past which have been found confiscatory by the higher courts.

Public utility regulation is not a novelty in principle. The commission is but an improved means of control. A distinct step forward has been taken by the change to the latter, though it is, of course, true that the principles governing such bodies are constantly undergoing modification as a result of legal decisions handed down by our higher courts in corporate problems.

As to Mr. Britton's comment that "I cannot forbear to repeat what I have often said—that the corporations of this state are satisfied with regulation, and that so far as the other companies mentioned by Mr. Metcalf are concerned regulation had nothing to do with their financial straits," there appears to be some difference of opinion, for other men interested in public utilities and their management hold views differing widely from those expressed by Mr. Britton.

The writer agrees with Mr. Britton, however, that the present commission has been helpful in solving the difficulties in which some of the corporations have found themselves.

LEONARD METCALF,
Consulting Engineer.

Water the Chief Factor in the Making of Good Concrete

SIR: Referring to the article on "Water the Chief Factor in the Making of Good Concrete," by Nathan C. Johnson, in your issue of Dec. 30, 1916, page 790.

What Mr. Johnson says in regard to the menace of "day's-work planes" and of laitance is very true. This may be overcome by boring a few holes near the top of the forms and allowing the "cement cream" to run away, also by leaving keyways of sufficient depth and breadth to insure a good bond for the next day's work.

I quite agree with Mr. Johnson's remarks about a too wet mix. Over-wet concrete should never be dumped into a column form from the top and so allow the larger aggregate to collect at the bottom. If it is necessary to fill from considerable heights, the material may be lowered into place, and in the case of a column the wet plastic concrete may be allowed to slide into place on a plank of the same inside width as the column form.

HERBERT CANTWELL,
Beauharnois, Que. Paper Mill Engineer.

September Railroad Income 10 Per Cent More Than in Year Before

Gross operating revenues for September, 1916, on the large steam railroads of the United States, according to a bulletin issued by the Bureau of Railway Economics, were \$1,409 per mile, showing an increase of \$158, or 12.6 per cent, as compared with September, 1915. Operating expenses were \$881, an increase of \$107, or 13.8 per cent. Net operating revenue, therefore, was \$528—an increase of \$51 or 10.6 per cent, and operating income was \$468—an increase of \$43, or 10.0 per cent. The operating ratio was 62.5 per cent, as compared with 61.9 per cent in September, 1915. Considering the three main districts, the respective ratios for September, 1916, and September, 1915, were as follows: Eastern, 65.8 and 62.8; Southern, 65.7 and 66.8; Western, 58.1 and 59.5.

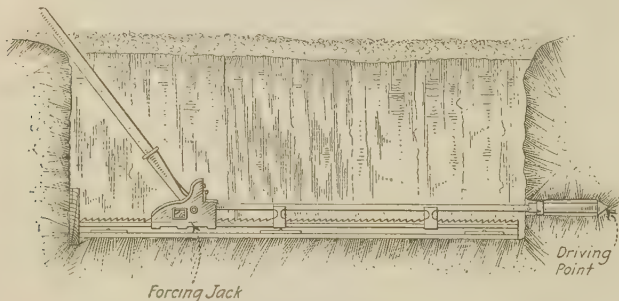
HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

CONTRIBUTIONS to this section are solicited, and if found available will be paid for. They must be SHORT, and should be accompanied, if possible, by photographs or sketches.

Pipe Up to Four-Inch Diameter Driven Under Pavements

USING the method shown in the drawing, a large Eastern electric service company has saved considerable trouble and expense in installing pipe conduits up to 4 in. diameter. The method, which avoids cutting through pavements and digging ditches which would obstruct traffic, consists in digging a pit at the side of the pavement on the bottom of which the jack may be laid



JACK DRIVES PIPE UP TO 4 INCHES IN DIAMETER UNDER PAVEMENT

in a horizontal position. The cage on the jack, the front of which is provided with a groove and clamp which can be adjusted to pipe ranging from $\frac{3}{4}$ in. to 4 in. diameter, is set at the far end of the rack. A short length of pipe is then inserted, to the front end of which is screwed, by means of an ordinary coupling, a steel nose. The jack is operated by a hand lever, forcing the pipe ahead into the ground. When the length of the rack has been traveled, the cage is carried back to the starting point and a new length of pipe inserted. The jack, similar in operation to an ordinary track jack, but with a much longer travel, is bolted to a plank when in use. It was furnished by the Duff Manufacturing Company. The method was described in a recent issue of the *Electrical World* by C. L. Dalrymple.

Suction Dredge Digs Pond for Itself in Gravel Pit

By R. M. CREAMER
Orangeburg, N. Y.

IN a gravel pit near Palermo, Cape May County, in southern New Jersey, where hand loading had previously been employed for excavating a few feet until ground water level was reached, a 6-in. suction dredge was recently installed which dug a hole for itself to float in and has since been used to load railway cars by discharging directly into them.

The pits in this part of New Jersey were formerly worked by hand at considerable expense. The larger part of the sand and gravel was left untouched by this method because ground water level was reached at shallow depths. The dredge at Palermo is mounted on a 12 x 30-ft. decked scow, and consists of a 6-in. centrifugal pump run by a belt from a 30-hp. gasoline engine. The hull was built and the machinery assembled in the pit. A hole was excavated by hand at the suction large enough to give sufficient water for priming the pump. The pump was then started and run until a basin large enough to float the dredge had been formed. The hull was then undermined and slid into the pond.

It is reported that this dredge, discharging run-of-the-pit material through a flexible-joint pipe line, can load a 50-ton gondola car in about 20 minutes. The water discharged overflows the sides of the car and runs back into the pit. When gravel alone is wanted, the dredge discharges on a stationary screen, the sand and water flowing through and the gravel sliding off into the car. The sand piles up around the screen, so that when sand alone is wanted it is only necessary to throw the suction of the dredge into the bank of the pond at this point and pump directly into the cars. The pit is on the edge of a salt marsh where the ground surface is about a foot above high tide.

The 8 or 9-ft. depth of sand and gravel made available by this installation was evidently deposited following a considerable settlement of the coast, as at that depth a second layer of sod, containing roots and stumps, is encountered, overlying a further deposit of sand and gravel.

Proper Guy Anchorage Saves Cable

By R. E. POST

U. S. Reclamation Service, North Yakima, Wash.

IN the use of derrick or tower guys it is common experience that the least deterioration occurs while the guy is in actual service. Usually the guys are discarded because of kinks made by fastening them around small anchor devices. Perhaps the worst wear that



KINKED AND ROTTED GUY ENDS AVOIDED BY THIS RIGGING

comes to the guy in actual use is caused by the rotting of the core when the guy is fastened around a deadman and covered with dirt.

In order to avoid these causes for the short life of guys, and to make it possible to realize a reasonable percentage of their theoretical life, the rigging shown in the illustration was used with good success on the Keechelus Dam built by the U. S. Reclamation Service at Meadow Creek, Wash. While this anchorage rigging is not new, inferior ones are in such common use, according to the writer's experience, that the method is worth passing on.

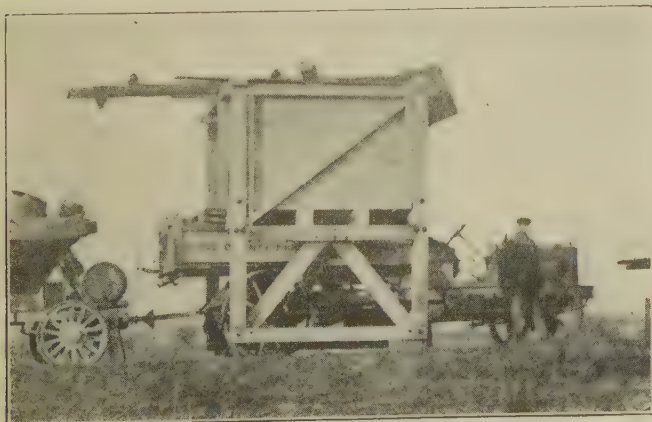
The sheave and clevis are fastened to a piece of well-greased scrap cable of ample strength attached to the deadman, eyebolt or stump. When the derrick is moved, the kinks or rotted core, or both, will be in the piece of scrap and not in the guy.

This method of fastening makes it very easy to tighten a guy, for the sheave aids instead of retarding the process, as is the case with most fastenings. It promotes safety by keeping guys in first-class shape and eliminating the temptation to use guys after they become kinked. By using this anchor rigging, clevis attachments to the guy cap and galvanized rope with soldered ends, derrick guys can be made a quite permanent part of the equipment, as theoretically they should be.

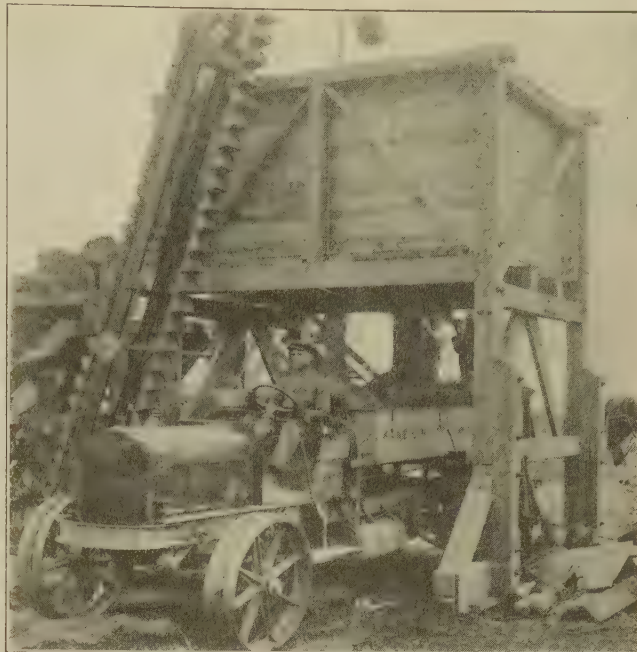
Motor Truck Carries Own Loading Hopper from Job to Job

A PORTABLE gravel-producing plant which is carried from place to place by the motor truck which is used to load is in service on road construction work in Kane County, Ill. The portable crushing and screening plant for which the bin was built is run by power from a gasoline tractor. To avoid having the bin top-heavy, the screen is located at the foot of the elevator. The plant is supplied with gravel and boulders up to 10 in. size by teams and slip scrapers. It can produce more than 200 cu. yd. per day.

The bin, which holds 15 yd., was designed so that the trucks could drive under it. The posts on which it is supported are made in two sections, the lower ends of the posts and the sills being taken off and placed in the truck body for moving, while the upper portion of the structure is lowered to the truck. This construction can be plainly seen in the photographs, one of which



TRUCK TRANSPORTS ITS OWN HOPPER



LEGS OF HOPPER COME OFF FOR MOVING

shows the bin en route on a White motor truck; the other shows the bin in use.

The plant was designed and used in building gravel roads under the direction of George N. Lamb, superintendent of highways, Kane County, Ill.

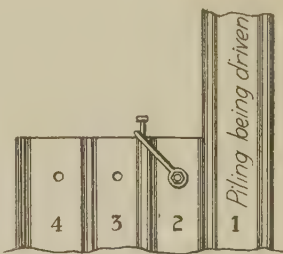
Shackle Prevents Sheet Piling from Creeping Below Grade During Driving

By FRED C. TODD
Norwood, Ohio

CONSIDERABLE difficulty encountered at Ohio River Dam 39 in holding steel sheet piling to the proper elevation during driving was overcome by securing each pile to the next with a long shackle, as shown in the sketch.

The piles were of the 14-in. arched-web type, 40 ft. in length. They are a permanent installation, driven on the upper edge of the navigable pass foundation, and extending 3 ft. into it. In the sketch, pile 1 represents that being driven, while piles 2, 3 and 4 have been previously driven.

During the driving of pile 1, pile 2 would creep below grade, due to the friction between the piling. In some cases the creeping of pile 2 would commence as soon as the driving was started on pile 1. If this had been allowed to continue until pile 1 was driven to grade, pile 2 would have been from 10 to 12 ft. below grade. The method used to prevent the creeping of the piling was to fasten a shackle to pile 2 with a $1\frac{1}{4}$ -in. short bolt, lay the other end of the shackle over the top of pile 3, and insert a bolt in the joint between piles 2 and 3 to



SHACKLE STOPS CREEPING

prevent the shackle from being pulled off. After the shackle was in place, pile 2 would continue to creep for about an inch until the shackle became tight. In one or two cases the friction developed in driving was so great that pile 2 would continue to creep, carrying with it pile 3. This necessitated an additional shackle between piles 3 and 4.

The shackle was about 15 in. long, made from 1-in. soft steel. The piles were driven with 3½ and 4-ton steam hammers. The work at Dam 39 is being done by government forces, with L. J. Prell, assistant engineer, in charge.

Face Gravel Pit South to Save Dynamite in Winter

IN IOWA some gravel pits are kept open during the winter, and the following instructions for their care are given in the *Service Bulletin* of the State Highway Department:

Cover the surface with a heavy coat of straw. This will keep out the frost and will save much dynamite. Open up the runway on an easy grade at the south side of the gravel pit, so that the sun will be on the sides and floor of the pit all day. In opening the pit, back down the runway and load so that the pit is circular. As soon as possible drive into the pit and make a circuit in coming out. Keep the bank caved down from the top, throwing out all black dirt and frozen chunks. Always load from the bottom and clean up as you go. Keep pushing back the straw as it is necessary to uncover for more material. Cave down the last thing at night and throw to the center all frozen chunks that cannot be used for road material. Be sure that the walls of the pit are entirely covered with loose material when left for the night or over Sunday.

Wire Rope Slings Best for Pulling Sheeting with Hammers

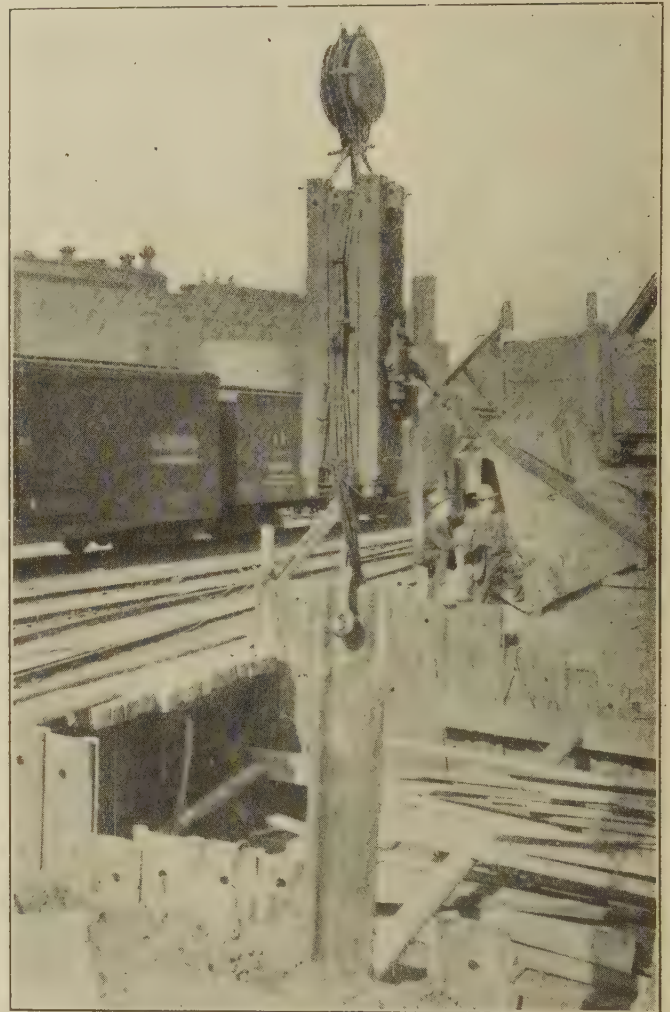
By A. B. LUEDER
Omaha, Neb.

WIRE ROPE, which cannot crystallize and break as does strap iron, has been used entirely in rigging an inverted hammer for pulling 35-ft. steel sheeting on work under the writer's charge at Omaha, Neb.

Robert Melvin, the first American to use a hammer in this way, found on the Lexington Avenue subway work in New York that the steel holding and pulling strap crystallized and broke, and substituted for it four parts of wire rope. On this work the idea has been carried further and the entire pulling rig made of wire rope. Sheet piles 35 ft. long which have been concreted in for 3 ft. at the lower end and completely backfilled have been removed by this equipment without changing the regular rigging on the derricks. Two parts of line are used in the derrick falls, with which a direct pull of not more than 8 tons can be made. From experiments carried out on the work it is evident that without the use of the hammer a direct pull of 75 to 100 tons would be required to start the piles. The hammer, however, pulls them without difficulty, the rate of starting being about the same as the rate of penetration in driving just before the piles reached the proper depth.

The wire rope rigging has been found on this work easier and quicker to change than straps, in addition to the advantage that the wire rope does not crystallize. The pulling is being done with a No. 6 McKiernan-Terry hammer, which was adjusted for the work on the advice of the makers by slightly changing the steam ports. This adjustment overcame a tendency for the hammer to break its top head.

The work on which this method is in use is being car-



WIRE ROPE SLINGS EASY TO RIG AND DO NOT CRYSTALLIZE

ried out for the Omaha Electric Light & Power Company by the Phoenix Construction Company. The work is under the direction of the Jarrett-Chambers Company, construction manager, with the writer as superintendent and B. I. Moran as general foreman.

Record-Breaking Year for Coke

The coke output of the United States in 1916 broke all records. More than 35,000,000 tons of beehive coke was manufactured—27 per cent more than in 1915 and 500,000 tons more than the record-breaking total in 1910. By-product coke amounted to 19,200,000 tons, which is 5,000,000 tons, or 36 per cent, more than the production in 1915. The total coke production, according to estimates prepared by C. E. Leshner of the U. S. Geological Survey, was 54,300,000 tons, an increase over 1915 of 12,700,000 tons, or 30 per cent, and over 1914 of 8,000,000 tons.

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

George H. Pegram Made American Society President

Engineer Prominently Identified with New York City Railways Elected at Annual Meeting

George H. Pegram, chief engineer of the Manhattan Elevated Railroad, the Interborough Rapid Transit Company, the Rapid Transit Subway Construction Company and the New York Railways Company, was elected president of the American Society of Civil Engineers at the annual meeting in New York this week. Mr. Pegram's experience in the civil engineering field covers a period of 40 years, most of it in railroad work.

He was born Dec. 29, 1855, at Council Bluffs, Iowa, and was graduated from Washington University in 1877 at the head of his class. His first professional work was on the construction of the Utah & Northern Railroad, now part of the Oregon Short Line, in Idaho. In 1879 he was appointed chief assistant to Charles Shaler Smith, the noted bridge engineer. Two years after that appointment he was made chief engineer for the Edgemoor Iron Company of Wilmington, Del. Mr. Pegram visited Europe in 1886 and on his return to the United States established consulting engineering offices in New York City. The Missouri Pacific Railway retained him as its consulting engineer in 1889, and in 1893 he became chief engineer of the Union Pacific system. During the construction of the Pioneer Electric Power Company's plants at Ogden and Salt Lake City he was also consulting engineer to that corporation.

In 1898, when the construction of a subway in New York City first was being urged strongly and seemed likely to be undertaken, the Manhattan Railway Company decided to build a number of extensions. It was then that Mr. Pegram was offered the position of chief engineer. The extensions never developed, but the introduction of electricity as a motive power added to the engineering department's responsibility.

His appointment as chief engineer of the Interborough Rapid Transit Company and of the Rapid Transit Subway Construction Company came in 1905. Seven years later he was made chief engineer of the New York Railways Company. Among important works to be credited to him are the invention of the Pegram truss, the design of the Kansas City Elevated Railroad and that of the trainshed of the Union Terminal Station at St. Louis. He also directed the design and construction of the combined highway and railroad bridge over the Arkansas River at Fort Smith. This structure is believed to contain the longest Pegram truss ever built.

Human Side of Engineering Holds Attention at American Society Meeting

Debate Centers on Compensation and Conditions of Employment for Engineers and Opportunities for Broader Service—Concrete and Valuation Reports Received

Despite the readiness with which the annual meeting of the American Society of Civil Engineers on Jan. 17 swept aside the few rather feeble protests and accepted the report of its special committee on compensation as truly indicative of how the average engineer fares financially, the subject and correlated questions pertaining to engineering conditions and opportunities—what

strength of the discussions it is expected to evoke.

For the first time the meeting was held in the auditorium of the United Engineering Society Building. Sometime after adjournment 720 registration cards had been given out.

Directors' Report

The annual report of the board of direction showed a gain in membership of 283, as compared with 231 for the previous year. The total membership Jan. 1, 1917, was 8192.

The library now contains 26,858 bound volumes, 49,170 unbound volumes, 8043 specifications and 5275 maps, photographs and drawings—a total of 89,346 and a gain of 2638. Since Oct. 1, 1916, the library has been under the management of the United Engineering Society Library Board, although still on the shelves of the society house. It is expected that shelving will soon be ready at the Thirtieth Street building.

The plan for increasing the height of the United Engineering Society Building three stories is being executed. The four columns extending through the present building have been completed, and a contract for the remaining work has been awarded. While there has been much delay on account of slow deliveries, it is hoped that the building will be ready for occupancy toward the latter part of the coming summer. The Fifty-seventh Street property has been placed on the market.

Building Expenses

The society has paid \$54,000 toward the building expenses, for which the society was to furnish the funds, the total cost not to exceed \$250,000. The building committee finds, however, that due to the great and unexpected increase in the cost of materials the total cost will exceed \$250,000, and has asked each of the four societies to become responsible for its share of an additional amount, which it is estimated will be \$50,000.

In order to raise funds to meet the necessary expenses of building, a mortgage of \$200,000 at 5 per cent has been placed upon the society's property, which was entirely free. Only \$20,000 of this amount was drawn at the time of the execution of the mortgage, and arrangements have been made by which additional amounts will be received

New President of American Society of Civil Engineers



GEORGE HERNDON PEGRAM

might be called the human side of engineering—would not down. The question of the engineer's education, his early association with engineering societies, his opportunities for marketing his services to better advantage in both this and foreign countries and the desirability of his taking a much larger part in public affairs, all these matters were discussed. On the other hand, none of the technical reports were discussed in their technical aspects, although the final report of the committee on concrete and reinforced concrete was presented and accepted, and that of the committee on valuation was also accepted subject to such revision as the committee cares to make on the

when needed, thus saving unnecessary interest charges.

What Is an Engineer?

The first special committee to report was that on engineering education. After its chairman, Desmond Fitzgerald, had explained briefly why the committee had been unable to make a report, Dr. C. R. Mann spoke briefly on the progress of his investigation. The questions sent out during the last year, he said, confirmed exactly, regardless of the length of experience of those who replied, the conclusions previously reached as to the relative importance of the various attributes needed by engineers. As to what this could show the engineering school, he mentioned two principal points. He said engineering education must give the student enthusiasm, or "motivation," and common sense, or understanding of the relationship between things. As an instance of failure to do this, Dr. Mann mentioned the division of instruction into such departments as that of mathematics, which are likely not to know the specific needs of the engineer.

Dr. Mann hopes to be able to present a complete report within a few months.

Roads and Concrete

The special committee on road construction and materials, through George W. Tillson, stated that because of the absence of its chairman on military duty in Texas, it had been unable to make a final report, but hoped to do so next year. Its progress report it had shaped to the suggestions made at the annual meeting last year, making the report broader in scope.

The final report of the special committee on concrete and reinforced concrete, presented by its chairman, J. R. Worcester, was received with the thanks of the society.

Compensation of Engineers

Nelson P. Lewis, chairman of the committee on employment and compensation, presented the committee's final report. Suggestions made by two or three members that the committee had not got at the heart of the question included statistics on seventy-one members of two groups of engineers in Connecticut cities, all eligible for membership in the society. Their average compensation was \$1,480. Ten were members of the society, and their average was \$3,270. The views of the chairman, however, that many in engineering offices could not accurately be termed engineers, and that the committee had done as well as possible with the material available, evidently bore weight, and when the question was put to a vote only one dissenting vote was heard.

The report of the committee on valuation was presented as final, with the proviso that the committee revise it if it saw fit in response to the discussions that are expected to be evoked by it. Charles Rufus Harte, speaking for the American Electric Railway Association, suggested that before closing the

matter the committee confer with the valuation committees of other organizations relative to variations in terminology. Progress was reported by the committee on steel columns and struts, that on stresses in railway track and that on the bearing value of soils. As the chairman of the committee on national water law was not present, that progress report was not read.

More About the Engineer

Under new business a motion was made that the board of direction be asked to consider the appointment of a special committee to investigate opportunities for American engineers in Russia and South America. Another proposed that consideration be given to the forming of student branches in the leading technical schools, similar to those of the American Society of Mechanical Engineers.

The most radical motion, by P. M. Churchill, called upon the board to consider the appointment within a month of a committee of three to formulate plans for the better marketing of engineering services, other societies to be co-operated with, the committee to be authorized to spend not to exceed \$5,000 and if necessary employ a competent engineer to handle its investigation, and a report to be made at the next annual convention. The motion was embodied in a long letter from Mr. Churchill, who proposed the investigation just terminated by the discharge of the compensation committee, and who evidently was not wholly satisfied with the findings of that committee. He pointed out the desirability of statistics as to lost time, traveling expenses and other matters that would have a bearing on net compensation. He also emphasized the need for engineers to take a larger part in the administration of engineering expenditures, and called attention to the desirability of engineering exchanges to enable communities seeking competent engineering services to find them.

Engineering Exchange Needed

Brig-Gen. W. H. Bixby, formerly chief of engineers, U. S. A., emphasized the latter point by stating that he had known of cabinet officers seeking capable engineers and being unable to get any assistance whatever from the American Society in the matter. Another speaker pointed out that the engineering exchanges were among the most important functions of European societies.

All three of the foregoing motions were carried. The hour was then so late, the meeting having begun half an hour late, that the incoming president, George H. Pegram, spoke only a few words, after which the meeting adjourned.

Prizes were awarded during the year as follows: Norman Medal, to J. A. L. Waddell, for his paper on the possibilities of high-alloy steel in bridge construction; J. James R. Croes Medal, to C. E. Smith, for the paper on the history of the Little Rock Junction Railway bridge; Thomas Fitch Rowland

Prize, to E. L. Sayers and A. C. Polk for that on Lock 12 development, Coosa River, Alabama; James Laurie Prize, to William G. Grove and Henry Taylor, for that on the reconstruction of the Norfolk & Western's Kenova bridge; Collingwood Prize for juniors, to Harold Perrine and George E. Strehan, for that on cinder-concrete floor construction.

Officers for the coming year were elected as follows: President, George H. Pegram; vice-presidents, George W. Kittredge and George S. Webster; treasurer, George W. Tillson; directors—district 1, Alfred D. Flinn and Lewis D. Rights; district 3, William R. Hill; district 5, Arthur P. Davis; district 7, W. L. Darling; district 12, R. H. Thomson. Members of nominating committee—district 1, R. S. Buck; district 3, D. B. La Du; district 5, John S. Conway; district 6, A. J. Himes; district 10, A. O. Ridgway; district 11, Louis C. Hill; district 13, W. C. Hammatt.

Arrest Engineer Who Used Professional Connection to Defraud

Robert J. MacNoll, alias James Craig, bridge engineer and draftsman, who has during the last month obtained positions with consulting engineers of St. Louis and used those associations as a means of falsely obtaining funds, has been arrested, and will be charged with forgery and grand larceny. The gentleman in question entered the employ of C. E. Smith, consulting engineer of St. Louis, Dec. 2. Mr. Smith advanced funds, yet despite this kindness Mr. MacNoll used his connections with Mr. Smith, the closeness of which he enlarged on, to obtain money under false pretenses.

Mr. Smith, who put private detectives on Mr. MacNoll's trail, but had not yet found his man, announced the details at the Jan. 10 meeting of the St. Louis Engineers' Club. On information furnished by one of the members, Mr. MacNoll was found under the name of James Craig, and handed over to the authorities on the charges mentioned.

Henry Gordon Stott Dead

Henry Gordon Stott, superintendent of motive power of the Interborough Rapid Transit Company, since 1904 in charge of the entire operating force, including the subway, elevated and surface lines, died Jan. 15 at his home at New Rochelle, N. Y., in his fifty-second year. He was born in 1866 at Stennis, Scotland, and studied engineering at the College of Science and Arts, Glasgow, now the Glasgow and West of Scotland Technical College. Mr. Stott was employed on many electrical engineering works in England and on a power plant in Spain previous to his arrival in the United States in 1891. Ten years with what is now the Buffalo General Electric Company preceded his appointment with the Interborough in 1901. Mr. Stott has been a member of the American Society of Civil Engineers since 1908 and was made a director of the society in 1911.

Illinois to Consolidate Its Governmental Agencies

More than 100 existing governmental agencies in Illinois will be combined into nine departments if the "administrative code" which Governor Lowden is advocating is made a law. The directors of the departments will form the members of the Governor's cabinet and will be appointed by him. There will be numerous bureau chiefs under the di-

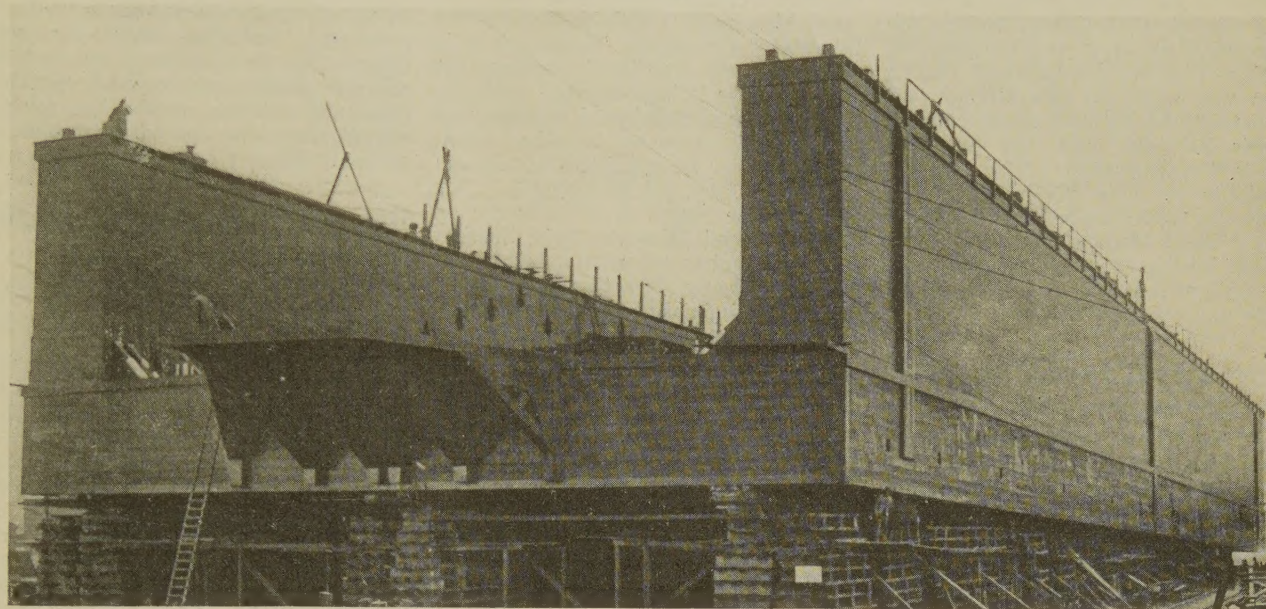
five normal schools, the State entomologist, legislative reference bureau and State historical library. Indications point to a speedy passage of the bill.

No New Chinese Railroad Contract

Newspaper reports dated Jan. 15 state that the Chinese Government has contracted with the Siems-Carey Railroad & Canal Company of St. Paul for the construction of an additional 300

New Jersey Governor Recommends State Highway Tax

Gov. Walter E. Edge, in his inaugural address Jan. 16 at Trenton, N. J., included in his recommendations many measures of interest to engineers. That the Passaic Valley Sewerage Commission be discontinued and its duties be turned over to the health commissioner, or to the North Jersey Water Supply



Drydock 450 Feet Long, with Square Ends, Launched at San Francisco

WHAT IS SAID to be the largest floating drydock ever constructed was successfully launched recently at Hunters Point, in San Francisco Bay, by the Union Iron Works. Although the structure is 450 ft. long, with square ends, it was launched end-on, in just the same manner as are large vessels. A careful inspection of the interior of the hull immediately after the launching showed that the impact which the square-

ended bow received as it entered the water had not injured the timbers in the slightest. The drydock is 100 ft. in extreme beam and has 80 ft. of clearance between wings. There are a solid keelson 16 in. square and two 10-in. sister keelsons. Both floor and deck are supported by timbers 16 in. square and 100 ft. long, each of which is braced with a double truss of heavy timber. There are 12 transverse watertight com-

partments. The depth from deck to floor is 12 ft. 9 in. and the extreme height from floor to the top of the wings is 42 ft. The dock will be flooded by twenty-two 12 x 24-in. valves. Ten motor-driven centrifugal pumps will be installed for pumping it out. The maximum lifting capacity of the dock will be about 12,000 tons. Dan Gillis of the Union Iron Works was in charge of the construction and the launching.

rectors, the scheme of organization being patterned after that of the federal government. The civil-service commission will remain an independent body and have jurisdiction over employees in all departments.

Departments having bureaus of interest to engineers and contractors are as follows: Under the department of labor it is proposed to consolidate the labor commissioners, free employment agencies, State factory inspection service, industrial board and the State board of arbitration. Under the department of public works will come the highway commission, the three canal and waterway commissions, Illinois park commissions, State architect, supervising engineers, the State examiners of architects and structural engineers. The department of health will include the boards of health, the food commissioners and food standard commission; but the State water survey and the geological survey will be placed under the department of education along with

miles of railway. Officials of the American International Corporation, the company that is financing the contract, state that to their knowledge no new contract has been signed. It is their opinion that the "300 miles of new road" is probably a part of the 1100 miles contracted for several months ago, and surveys of which have probably been started.

Introduce License Law in Indiana

A bill will be introduced in the Indiana legislature, now in session at Indianapolis, which will require all architects practising in that state to secure licenses. The measure is patterned after the Illinois statute, which has been in operation for nineteen years. Civil engineers will be exempted from the law's provisions unless they do the actual work of architects.

The bill provides for a board of five examiners composed of one consulting engineer, one member of the faculty of Purdue University and three architects.

Commission, was among the first recommendations. The new governor also urged a state highway system financed by direct state tax instead of by bonds, the creation of a state highway commission of eight members, to include three engineers, the universal installation of the patrol system, even to the extent of denying state aid to those counties which fail to provide for road patrols.

Public ownership of the waterfront, the co-operation of the state with cities in building marine terminals, the grouping of cities to take advantage of the law whereby streams may be dredged by the federal government, and greater co-operation by the state in movements to tunnel under the Hudson and bridge the Delaware river were also advocated. The extension of the state-use system, including work on roads by convicts and the abolition of prison contract labor under any subterfuge, were included in the prison reforms called for.

May Put Imperial Valley Works Under Federal Control

To determine on what conditions the credit and assistance of the Department of the Interior may be extended to the Imperial Valley, California, to complete the irrigation and flood-protection systems begun by the people of the valley, Joseph Jacobs, consulting engineer of the U. S. Reclamation Service, has been directed to investigate and report on the engineering works already constructed and those contemplated. Investigation to determine the advisability of placing under federal control the engineering works of the Imperial Irrigation District, comprising 750,000 acres, was asked by the directors of the district, the board of supervisors of Imperial County and the Imperial County Farm Bureau. This request was made by these organizations following the report made several months ago by Prof. Elwood Mead, who was engaged by them to make a survey, and who recommended that the works be placed under federal control.

First Annual Report for 1916 Comes from Columbia, S. C.

The first annual report for the year 1916 which has been received by the Engineering Record is from T. Keith Legaré, city engineer of Columbia, S. C., where the commission form of government is in operation. In view of the fact that municipal annual reports appear frequently a year or more late, it is to be noted that Mr. Legaré's report was submitted to the City Council on Jan. 9, the date of its first meeting in 1917. Mr. Legaré presents a concise statement of progress on the city's large-scale sewer and water-supply extensions, together with the year's work of the street department. For the ensuing year he recommends a system of street improvements involving gravel surfacing treated with asphaltic oil. The construction of new storm-water drains also is advocated.

Will Electrify Chicago Suburban Traffic Only

Electrification of its suburban traffic only in Chicago constitutes the offer renewed by the Illinois Central Railroad in a communication sent last week by C. H. Markham, president, to the City Council committee on railway terminals. The road has offered to electrify its suburban service, which involves complete relocation of the suburban tracks on the western side of the right-of-way for about 8 miles, a subway under the proposed terminal, complete electrification of 100 miles of track and new suburban passenger equipment.

Mr. Markham points out that the road is taking a step in advance of others within Chicago and that it is unfair to bind it to do further electrification. The proposed work will eliminate 500 steam passenger-engine movements per day north of Twelfth Street, producing about 70 per cent of the present smoke.

Half of Harbor Bill Said to Be Waste of Money

Board Similar to Interstate Commerce Commission Needed, It Is Thought

The contention that about half of the \$38,000,000 appropriated in the pending Rivers and Harbors bill is a waste of money is made in a minority report on the bill to be filed in the House this week by Representative James A. Frear of Wisconsin, a Republican member of the Rivers and Harbors Committee.

"A high-class board similar to the Interstate Commerce Commission is needed for the intelligent management of waterways improvements," said Mr. Frear. "Some such board controls waterways improvements in other countries wherever an intelligent waterways system has been put in force."

The Frear report says commerce on the Mississippi, Missouri, Ohio, Tennessee and Cumberland rivers and inland waters generally, excepting deep waterways, has diminished from 80 to 90 per cent in the last forty years.

"During that period," continues the report, "the government has appropriated \$159,000,000 for the Mississippi, \$60,000,000 for the Ohio, \$22,000,000 for the Missouri, and proportionately large amounts for other streams, while this decrease in commerce has steadily continued. Hundreds of small streams are being improved by the government with equally disappointing results. Colonel Townsend, one of the ablest of the army engineers and a member of the Mississippi River Commission, has urged a stop in waterways extravagance until one or two projects have been made commercially valuable."

\$19,000,000 Waste of Money

"Practically one-half of the \$38,000,000 contained in the pending waterways bill is wasted, including the greater part of \$18,000,000 given by the bill to eight inland streams. Army engineers have had full control in the determination of navigation needs and the amount of appropriations. Without business training, commercial knowledge or experience, this policy has resulted in wasteful projects, maintained all over the country, including those which are good, bad and indifferent. All join together annually in enormous omnibus bills. Not one project in four would pass Congress if standing in a separate bill, but omnibus measures carry those good, bad and indifferent because of the votes assured by this method."

Concrete Institute Announces Convention Program

The thirteenth annual convention of the American Concrete Institute will be held Feb. 8, 9 and 10 at the Hotel La Salle, Chicago. No sessions are planned for the afternoons of the first two days, so that members may visit the Cement Show. Meetings will be held in the mornings and at 8 o'clock in the evening. All of Saturday, Feb. 10, is to be

devoted to papers and committee reports.

Reports will be presented by the committees on reinforced-concrete and building laws, reinforced-concrete stand-pipe, sewers, concrete roads and paving, and building block and cement products. Committees on concrete bridges, chimneys and aggregates, and those on sidewalks and nomenclature will report Saturday afternoon.

Papers on concrete construction and design that will interest the contractor as well as the engineer form a program that promises to be well worth attention. Several specifications will be presented, including those for reinforced-concrete fenceposts, monolithic concrete sewers and revised specifications and building regulations for the manufacture and use of architectural stone, building block and brick.

Bids Wanted on \$1,000,000 Road Job in Illinois

Cook County, Illinois, will spend \$1,000,000 for 60 miles of hard roads this year. The first contracts will be let the first week in February and others will follow every two weeks thereafter until all of the sections from 3 to 9 miles long have been contracted for. Accessory information for the contractors bidding on the job has been worked up by the engineering staff of the county to show in map form the location of all sand, gravel and stone supplies within a reasonable distance of the various sections. Each of these material bases has been inspected so that the contractor is assured that acceptable material can be obtained from them. This does not mean that there may not be other plants, but the list is as complete as it is economically feasible to make it.

Railroad Sidings Mapped

On a second map which is to be furnished to the contractors taking out plans are shown all sections of roads to be constructed this year and all those now under construction and closed to traffic. All railroad sidings are marked with a figure which indicates the number of cars that can be accommodated. This information was furnished by the railroads, many of which stated that extensions would be provided if necessary. The map also shows the boundaries of all municipalities for the guidance of contractors. Some of the towns have traffic regulations which may preclude the use of heavy motor trucks without special permits. Camping privileges and other arrangements for housing the men may be affected in some cases.

Alternate bids will be taken for concrete of an average thickness of 7 in., asphaltic concrete 2 in. thick on a 6-in. macadam base, or on a 5-in. base of 1:3:5 concrete. Contractors are paid monthly in cash on 80 per cent of completed work. Cuts and fills have been balanced each 1000 ft. Asphaltic concrete roads must be maintained for one year.

Meters Are Barred Pending Spring Valley Valuation

A recent order issued by the Railroad Commission of California refused the Spring Valley Water Company permission to charge meter rates for residence service in San Francisco and directed the company to keep in effect the present flat rates until the commission shall fix a schedule. The commission is preparing to make a complete valuation of the Spring Valley Company's properties, as was announced on page 37 of the Engineering Record of Jan. 6. The future rates are to be based upon the findings of the commission.

One of the chief points at issue will be whether real-estate holdings of the company, which it has been claimed are not essential to the service which the company renders, should be included in the investment on which the company claims the right to earn profits.

Those who are seeking a reduction of the water rates claim that 31,566 acres of land owned by the company are not useful for water-supply purposes and should not be considered as such in any valuation of the corporation's properties fixed by the state for the purposes of rate schedules or sale of the properties to the city.

Wood-Block Paving to Be Discussed Next Week

The program for the annual convention of the American Wood Preserver's Association, to be held next Tuesday, Wednesday and Thursday at the Hotel Astor, New York City, has been prepared. Among the reports to be presented during the afternoon of the first day are those on publicity, promotion and education and on terminology, by E. A. Sterling and J. B. Card respectively.

The committee on purchase and preservation of treatable timber will report Wednesday afternoon, while that on wood-block paving will have the floor part of Thursday morning. The latter committee will recommend for adoption the specifications it submitted last year as information. It is the members' opinion that the clause pertaining to the method of computing absorption of preservatives should read as follows:

"In any given contract the blocks shall contain an average of not less than 16 lb. of water-free oil per cubic foot of wood at the completion of the treatment. Not less than 15 nor more than 17 lb. per cubic foot will be permitted in a given charge."

The committee has also prepared a specification on pitch filler.

Revise Concrete Building Code

A special committee to co-operate with the city in revising the code for concrete structures has been appointed by the Cleveland Builders' Exchange. Meetings will be held every Friday afternoon in the new City Hall, in charge of E. W. Cunningham, city building commissioner.

What Engineers and Contractors Are Doing

WILLIAM M. ACHESON, whose resignation as division engineer of division 6 of the New York Highway Department was noted in the Engineering Record of Jan. 6, has decided to remain with the highway department at Buffalo, N. Y.

L. T. PEARSALL, recently resigned from the engineering department of the Power Specialty Company of New York to become designer on furnaces and general rolling mill works for the Jones & Laughlin Steel Company. Mr. Pearsall was with his former employers for six years.

H. J. HANMER has been reappointed city engineer of Gloversville, N. Y.

J. A. WILLIAMS, formerly with A. A. Oldfield on drainage work in western Tennessee, is now with the Cuapaw Company at Bartlesville, Okla., on a geological survey.

A. J. PROVOST, consulting engineer, of New York City, is to give a series of lectures on water-supply purification and sewage treatment at Bellevue College.

RICHARD PFAEHLER, who for the last two years has been connected with the New York office of the Quebec Development Company, Ltd., and with the Southern Power Company and affiliated interests, has returned to Charlotte, N. C. He will have charge of the design of the new hydroelectric power developments at Bridgewater, N. C., and at Wateree, S. C. The Bridgewater development will include a reservoir having an available storage capacity of 12 billion cu. ft. and a power station of 27,000 installed horsepower. The Wateree project will have a powerhouse installation of 100,000 hp. Mr. Pfaehler was educated in Germany. He came to the United States in 1908, and located at Charlotte. He was associated with the Southern Electro-Chemical Company on its plant at Nitrolee, S. C., for obtaining nitric acid from the air.

W. B. BIDDLE has been elected president of the St. Louis & San Francisco Railroad to succeed the late W. C. Nixon. Mr. Biddle was formerly first vice-president of the road.

R. R. HAVENS of the U. S. Geological and Biological Survey has completed the mapping of 30 square miles along Lake Huron and is now at Lansing, Mich., preparing the completed map.

CLEVELAND TRINIDAD PAVING COMPANY has removed its office to the Arcade Building.

ARTHUR P. DENTON, retiring county engineer of King County, Washington, was the honorary guest at a dinner given recently by employees of the county engineer's office at the Northold Inn, Seattle. About forty

persons connected with the department were in attendance. Mr. Denton has served as county engineer for the last four years. For the preceding four years he was chief deputy engineer under J. R. Morrison. He is succeeded in office by S. J. Humes.

A. W. K. BILLINGS has returned from Barcelona, Spain, where for the last five years he has been manager of construction, managing director and vice-president of the Ebro Irrigation & Power Company, Ltd., and allied interests, in responsible charge of extensive hydroelectric construction and other work. More than 110,000 hp. has already been developed, one interesting feature being the construction of one of the largest dams in Europe under very unusual conditions. Previous to his work in Spain and elsewhere for the Pearson interests Mr. Billings spent two years in Pittsburgh and ten years in Cuba, principally on electric railway and power-plant construction. For two years he was in New York as engineering manager of J. G. White & Company, Inc. He has opened an office as consulting engineer at 115 Broadway, New York City, and will devote considerable attention to work in Europe and in Latin America.

FLOYD C. BROWN has been appointed assistant city engineer of San Jose, Cal.

FRED R. HESSER, formerly with the General Fireproofing Company of Youngstown, Ohio, has resigned to become sales engineer for the Fireproof Products Company of New York City, agents for the former concern. Mr. Hesser went to the General Fireproofing Company last November after four years as assistant engineer in the sanitary and highway department of the state of Kansas, and several years with the bridge department of the Kansas City Terminal Railway.

A. F. MATTSON has resigned from the city engineering department of Houston, Tex., to open consulting offices in the Beatty Building.

W. H. KUTZ, formerly with the valuation department of the Missouri, Kansas & Texas Lines, has been appointed city engineer of Parsons, Kan. Mr. Kutz spent about six years on engineering in the West before taking a course in engineering at the University of Kansas. After graduation in 1904 he engaged in contracting work at Rock Island, Mo., and later entered the real estate and insurance business. Ten years later he was appointed assistant city engineer of Oklahoma City and later became connected with the Atchison, Topeka & Santa Fe Railway. He had been in the valuation department of the Missouri, Kansas & Texas for about a year.

LEE H. POWELL has resigned as division engineer for the J. B. McCrary Company of Atlanta, Ga., to become chief engineer of road district No. 1, Cherokee County, Texas, with office at Jacksonville. It is proposed to con-

struct 100 miles of highway of local iron ore gravel with fund obtained from a \$200,000 bond issue. A maintenance fund for the next five years has been provided in the form of bonds amounting to \$50,000. Mr. Powell had charge of building part of the Dixie Highway in Leon County, Florida.

THE FIRM OF FARLEY GANNETT, consulting engineer, of Harrisburg, Pa., will hereafter be known as Gannett, Seelye & Fleming. Mr. Seelye has been associated with Mr. Gannett since Aug. 1, 1915, and Mr. Fleming has been associated with him since February, 1916. The offices have been removed to 204 Locust Street. The company has been retained by the Blue Mountain Consolidated Water Company to design a dam to form an impounding reservoir of about 300,000,000 gal. in the Kittatinny Mountains, north of Easton, Pa.

DWIGHT M. LEWIS has been made a member of the Iowa Board of Railroad Commissioners.

J. A. GUIHER, a member of the Iowa Board of Railroad Commissioners, has been made chairman of the board to succeed Clifford Thorne, resigned.

EDWARD D. CHASSEL has been appointed railroad commissioner of Iowa to succeed the late James H. Wilson.

BENJAMIN MCKEEN, formerly general manager of the Pennsylvania Lines West, and who was recently elected fifth vice-president, with office at Pittsburgh, is a graduate of Worcester Polytechnic School and of Rose Polytechnic Institute. Since 1885 he has been engaged in railroad work, a large part of that time in the maintenance departments. He had been general manager of the Pennsylvania Lines West since 1913.

A. A. MILLER has been appointed engineer maintenance of way of the Missouri Pacific Railway, with office at Little Rock, Ark.

A. A. COOK has resigned from the engineering department of the Central Railroad of New Jersey to become recorder of deeds of Mauch Chunk, Pa.

FRANK HELM has been promoted from office engineer of the Atchison, Topeka & Santa Fe Railway, western lines, northern district, to division engineer at Slaton, Tex.

GEORGE W. KNOPF has opened consulting offices in the Pennsylvania Building, Philadelphia, to specialize in the design and construction of industrial plants.

R. W. NEWTON has been made road engineer of St. Louis County, Minnesota, with headquarters at Duluth. He was formerly assistant deputy engineer of the Minnesota State Highway Commission.

H. MALCOLM PIRNIE, assistant engineer for Hazen, Whipple & Fuller, consulting engineers, of New York City, has been made a member of

the firm. Mr. Pirnie was graduated from Harvard University in 1911 and immediately thereafter entered the employ of his present associates, then the firm of Hazen & Whipple. Mr. Pirnie has recently been engaged on investigations of new sources of water supply for Watertown, N. Y.

F. T. HATCH, chief engineer of the Vandalia Railroad, with headquarters at St. Louis, has been appointed chief engineer maintenance of way of the St. Louis system of the Pennsylvania Lines West of Pittsburgh. This is the result of a recent reorganization.

HERMAN FINK has been appointed chief engineer of the Anderson-Cottonwood Irrigation District, Shasta County, California, to succeed E. I. Davis.

GOODMAN CONTRACTING COMPANY of New York City has removed its office to 90 Alexander Avenue, Borough of the Bronx.

Y. D. VESELY, formerly surveyor in the U. S. Army engineer's office at Memphis, Tenn., recently accepted a commission as second lieutenant in the army. He is now located at Fort Leavenworth, Kan.

R. H. STODDARD, superintendent for Welch Brothers & Hannaman, has been transferred from Kalispell, Mont., to Boise, Idaho, to direct work on the U. S. post office.

J. R. THOENEN has sold his interest in the firm of Curtis & Thoenen, road contractors, of Greenville, Ohio, to take a position as superintendent of the Garson (Ontario) mine of the Mond Nickel Company, Ltd., of Canada. Mr. Thoenen left the Mond company last year to engage in the contracting business.

JOSEPH R. GREENWOOD has resigned as general manager of the Ballwood Company to become associated with Charles H. Higgins, architect and engineer, New York City.

R. C. HATFIELD, superintendent for W. C. Owen & Company, of Cleveland, has moved to Ashtabula, Ohio, to superintend the erection of the new plant of the Pearce Tire & Rubber Company.

BERT W. MACY, engineer, of Salem, Ore., has been appointed city engineer of that city for the ensuing two years.

C. C. VAN ARSDOL has been retained by the commissioners of the Clearwater highway district, near Lewiston, Idaho, as consulting engineer for road construction to begin at an early date.

WHARTON CLAY, structural engineer, has been appointed executive secretary of the Military Training Camps Association of the United States, Central Department U. S. Army. The association works in co-operation with army headquarters, and its aim is to organize the business men of the Middle West

in the training-camp movement. Senior camps are to be held at Fort Sheridan, Ill., Fort Snelling, Minn., and Fort Riley, Kan. The method of procedure is to work in conjunction with business men and technical societies. Six men will be put in the field to handle the work under Mr. Clay, who was formerly in the engineering and sales department of the U. S. Gypsum Company. He will return to the commercial field at the conclusion of this campaign.

ALFRED KETTENBACH, assistant city engineer of Lewiston, Idaho, has been retained by the commissioners of the Clearwater highway district, near Lewiston, to take charge of road construction in the district. Surveys will be started at once.

J. D. McLAUGHLIN, who resigned some time ago from the engineering department of the Cleveland, Cincinnati, Chicago & St. Louis Railway, has been appointed to a position with the Baltimore & Ohio Railroad, with office at Jenkins, Ky. He will have supervision over the Shelby Creek branch between Shelby Junction and Jenkins, Ky.

L. B. ABBOTT, who for five years has been resident engineer for the Consolidation Coal Company in the Jenkins-McRoberts-Burdine territory in Kentucky, has been promoted to chief engineer over the company's plants in the Elkhorn and the Miller's Creek fields in eastern Kentucky. Mr. Abbott went to Kentucky five years ago from the Fairmont region of West Virginia.

C. R. ANDREW has been transferred from Wheeling, W. Va., to the U. S. engineer office at Charlestown, W. Va., in connection with work on the Kanawha River.

PARKER & MOCK is the name of a new engineering and architectural firm that has been incorporated by J. C. Parker and E. T. Mock. The company has opened offices in the National Realty Building, Tacoma.

M. R. LEWIS, U. S. assistant irrigation engineer, has been transferred from Twin Falls to Boise, Idaho.

Civil Service Examinations

United States—Examinations will be held Feb. 7 for junior land appraiser, salary \$900 to \$1,500. Applicants should fill in Form 2039. Applicants for position as aid in the Coast and Geodetic Survey will be examined Feb. 7 and 8. Examinations will be held Feb. 27 and 28 for assistant engineer in forest products, salary \$900 to \$1,200. Form 1312 should be filled in by applicants for the last two positions.

On March 14 examinations will be held for aid and computer in the Coast and Geodetic Survey, draftsmen of various kinds, and for junior civil engineers. Examinations for topographic draftsman (Panama Canal) and for laboratory assistant (Bureau of Standards) will be held April 11.